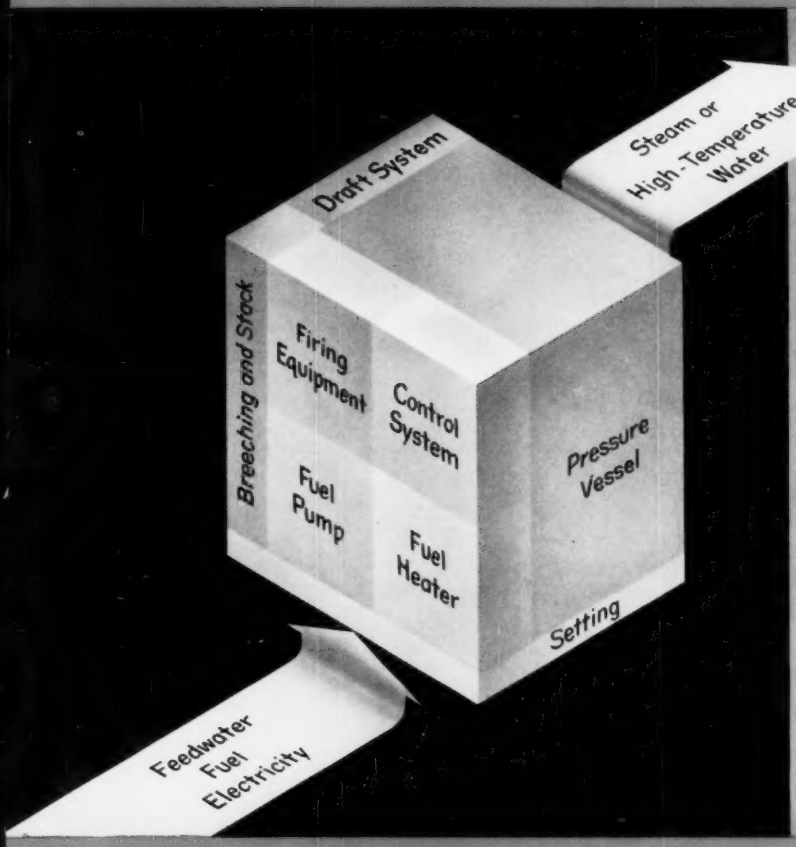
For engineers who design and manage the power and plant services

Power

AUGUST 1958 • ONE DOLLAR

A McGRAW-HILL PUBLICATION



Packaged Boilers

a 24-page report • 77

Also in this issue

New British gas turbine.....102
How Sterlington logs data.....104
PTG design for multivoltages.....106
Train instrument men, fast.....113
Make area-disaster plans now.....116
Honing can speed maintenance....118
Metallic packing seals gases.....120
Atomize oil with natural gas?.....123
How motors lick the weather 124
Motor tips for your shop men.....126

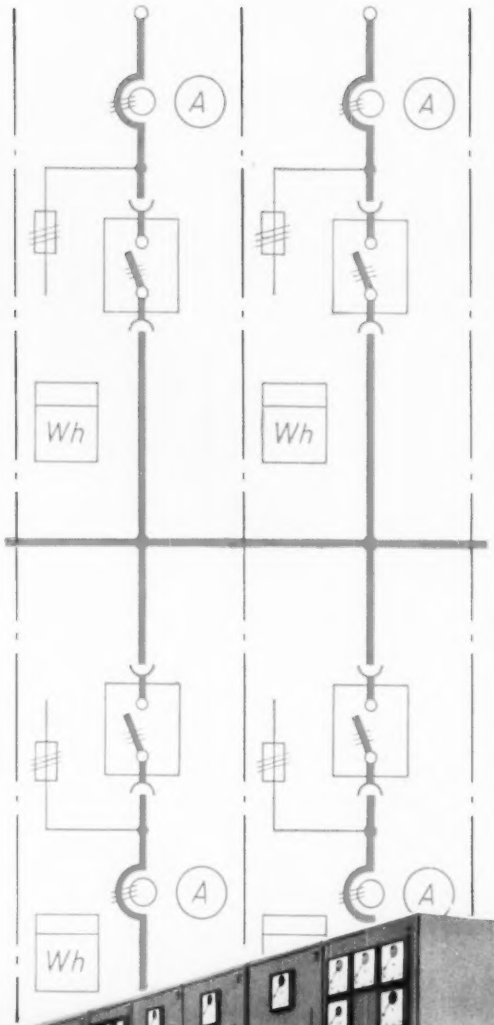
AEG

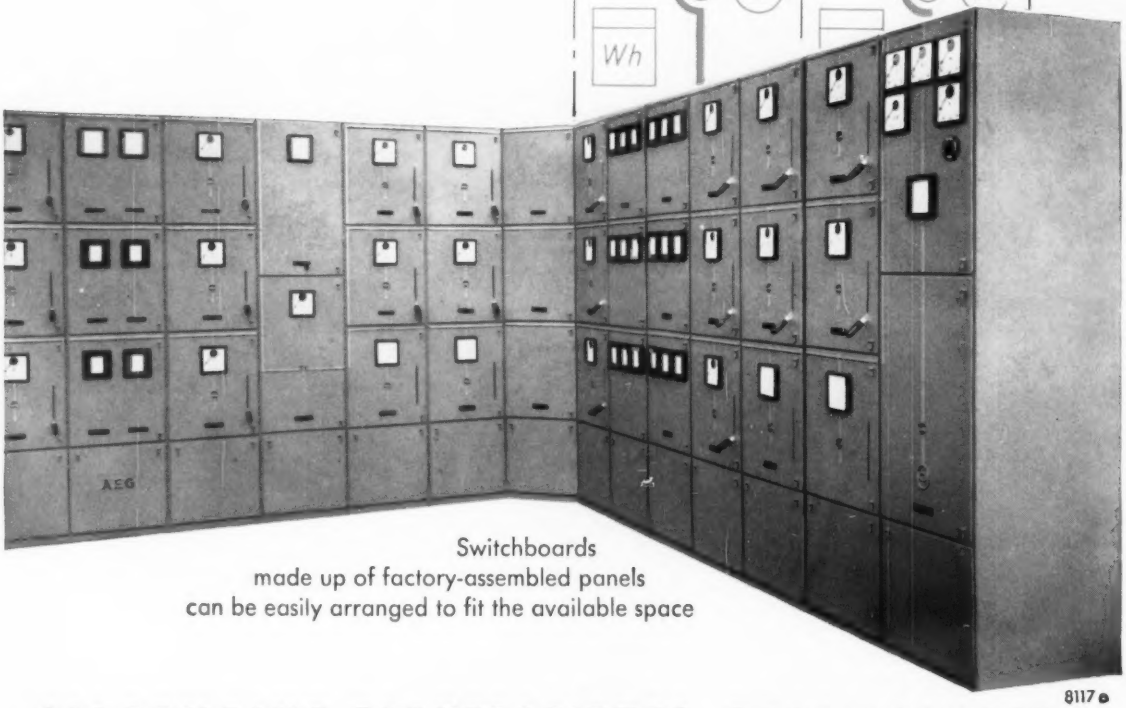
Factory-assembled panels for low-voltage switchboards

Designed to save space with a clear layout.
Metal clad for accident prevention.
Cellular-type for reliable functioning.
Truck-mounted breakers for safe and easy maintenance.

Quantity production of standard components
leaves little installation work on site
and facilitates subsequent extension.

The wealth of AEG's experience in building up
low-voltage switchboards from factory-assembled
panels is at your service.
Consult AEG when planning your switch plant,
and you will have control gear tailored
to suit your own needs.





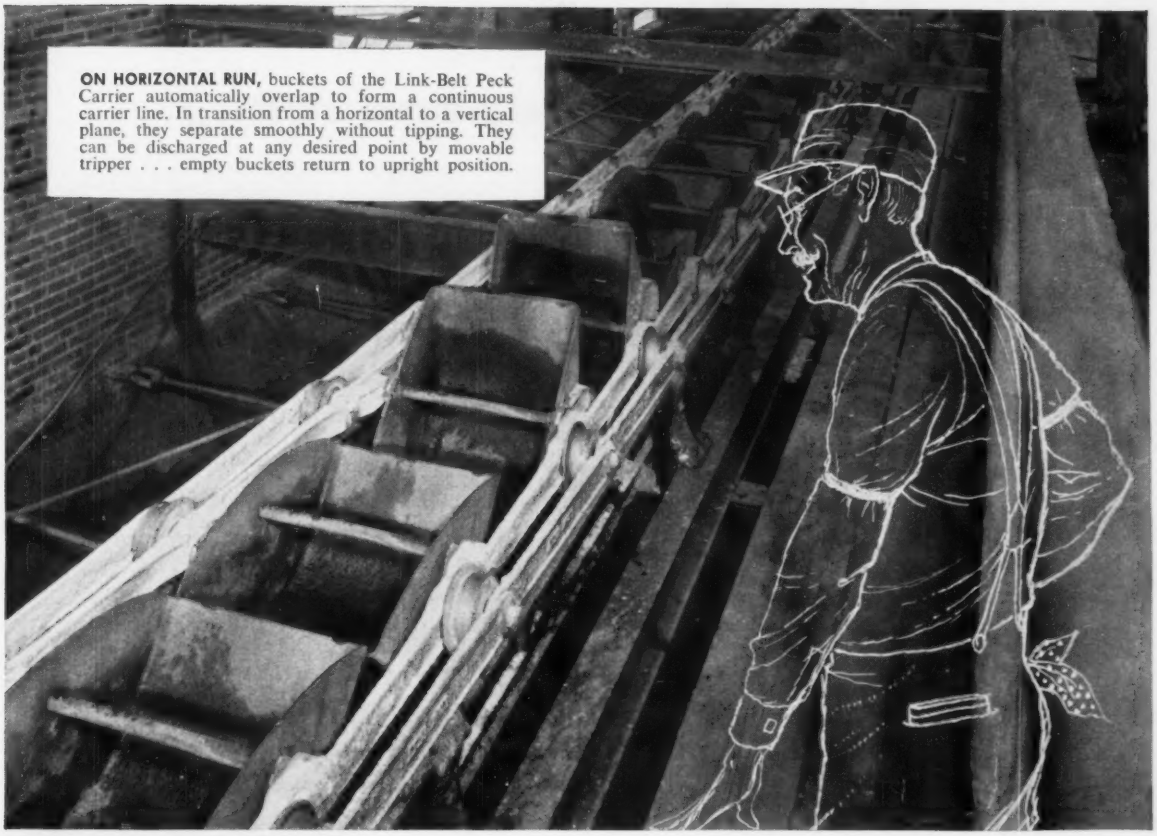
Switchboards
made up of factory-assembled panels
can be easily arranged to fit the available space

8117 b

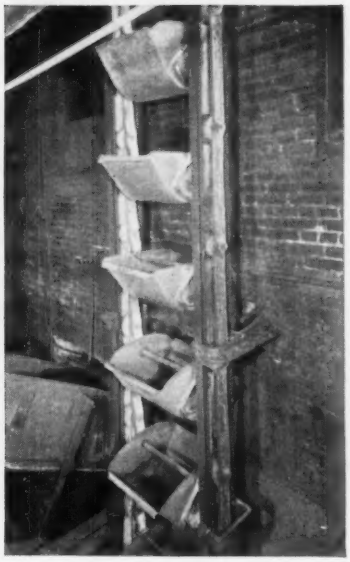
ALLGEMEINE ELEKTRICITÄTS-GESELLSCHAFT

Berlin (West) EXPORT DEPARTMENT Frankfurt (Main)

55 years, 3 million tons of coal
...and still going strong



ON HORIZONTAL RUN, buckets of the Link-Belt Peck Carrier automatically overlap to form a continuous carrier line. In transition from a horizontal to a vertical plane, they separate smoothly without tipping. They can be discharged at any desired point by movable tripper . . . empty buckets return to upright position.



UP TO BUNKERS. Peck Carrier at South Shops of L. & N. R. R. in Louisville, Kentucky, first elevates coal to top of bunkers, then carries it horizontally to discharge points. Carrier also serves as an ashes handling system—from furnaces to ashes bin.

LINK-BELT Peck Carrier installed in 1903 still uses original chain and drive

In a half century of service, the Peck Carrier at the South Shops of the Louisville and Nashville Railroad Company has traveled an estimated 52,000 miles. Yet it performs as efficiently today as in 1903—still uses the original chain and drive . . . half of its original buckets.

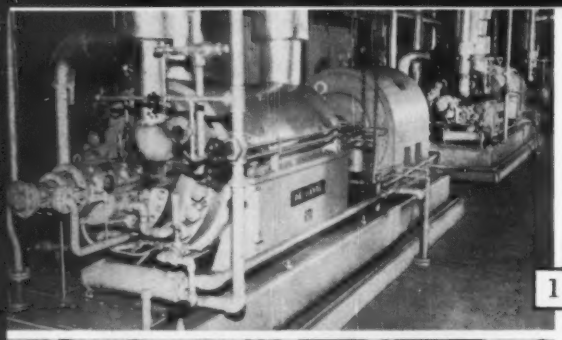
The durability demonstrated here makes Link-Belt's Peck Carrier the low-cost answer for moving coal both vertically and horizontally over the same route year after year. It can travel any combination of paths . . . permits continuous flow of coal from unloading to storage without need for transfer points. This combination elevator-conveyor consists of pivoted buckets suspended between two strands of chain. Buckets are mounted to remain upright except when dumping. Especially important: coal never comes in contact with rotating pins, bushings, rollers of the chain.

For full information on the complete line of Link-Belt coal handling equipment, call your nearest Link-Belt office. Or write for Book 2410.

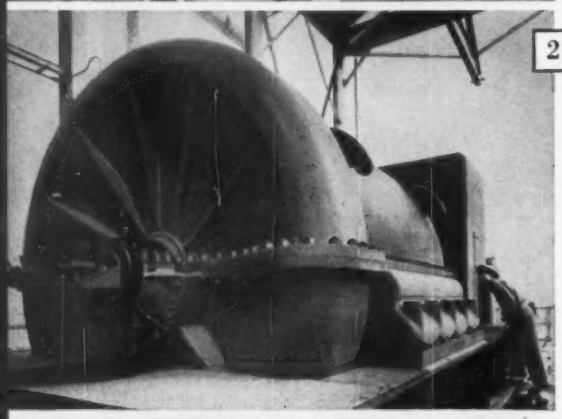
LINK-BELT

COAL HANDLING EQUIPMENT

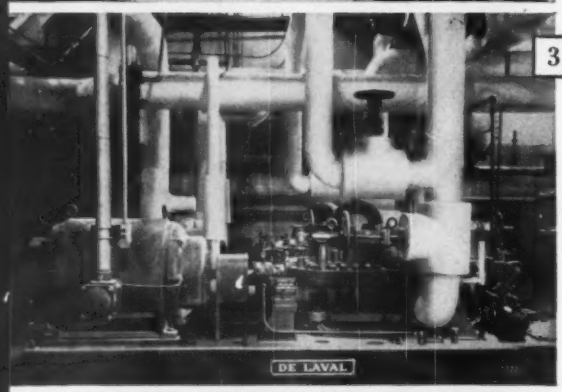
LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World. 14.920



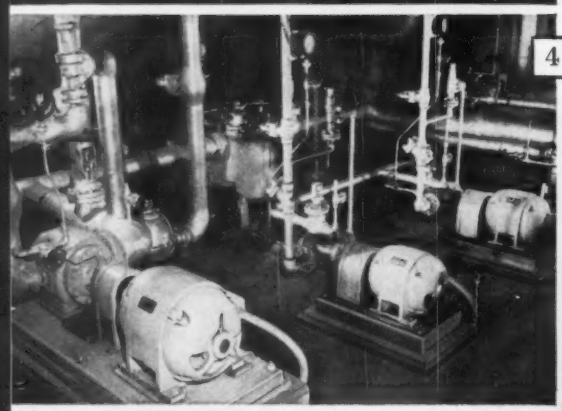
1



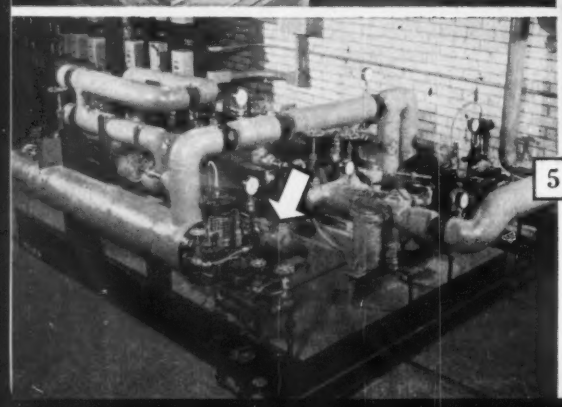
2



3



4



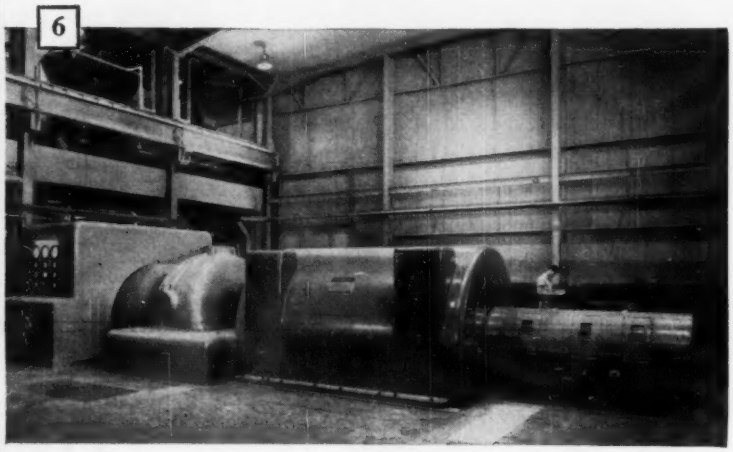
5

DE LAVAL

designs for dependability

Machines that *stay* in service year in and year out are the most economical. Since 1901, De Laval has supplied quality-designed pumps, compressors, and other vital equipment for industry. Each unit is designed for dependability and built by master craftsmen. As a result, the De Laval name plate is your assurance of reliability. Literature is available on all equipment shown on these pages.

1. Barrel type boiler feed pumps
2. Centrifugal compressors
3. Centrifugal pumps for many services
4. De Laval IMO pumps for fuel oil transfer
5. De Laval IMO pumps for fuel oil burner service
6. Multi-stage turbine generators



6

DE LAVAL

Steam Turbine Company

815 Nottingham Way, Trenton 2, New Jersey

DL-401

In Power this month

AUGUST 1958 • VOL. 102 • NO. 8 • 76TH YEAR

Editorial: Let's kill "boiler horsepower" 73

DESIGN AND EQUIPMENT APPLICATION

PACKAGED BOILERS: A 24-page special report 77
- Firetube designs are efficient for moderate-sized applications 79
- Watertube models produce up to 100,000 lb per hr 85
- Firing equipment success depends on time, temperature and turbulence 91
- Combustion controls give crisp response to load swings 95
- Safety controls are watchdogs to prevent damage 96
- H-t hot water and thermal liquids spur design improvement 98

Nuclear notes: News briefs on the latest developments 101
Britain's first steel-mill gas turbine has a 2500-kw net output 102
Transistorized digital data logger keeps tabs on Sterlington plant 104
Here's the pattern for a sound PTG plan in multivoltage labs 106
Data sheet: Concentration of gases and vapors 109

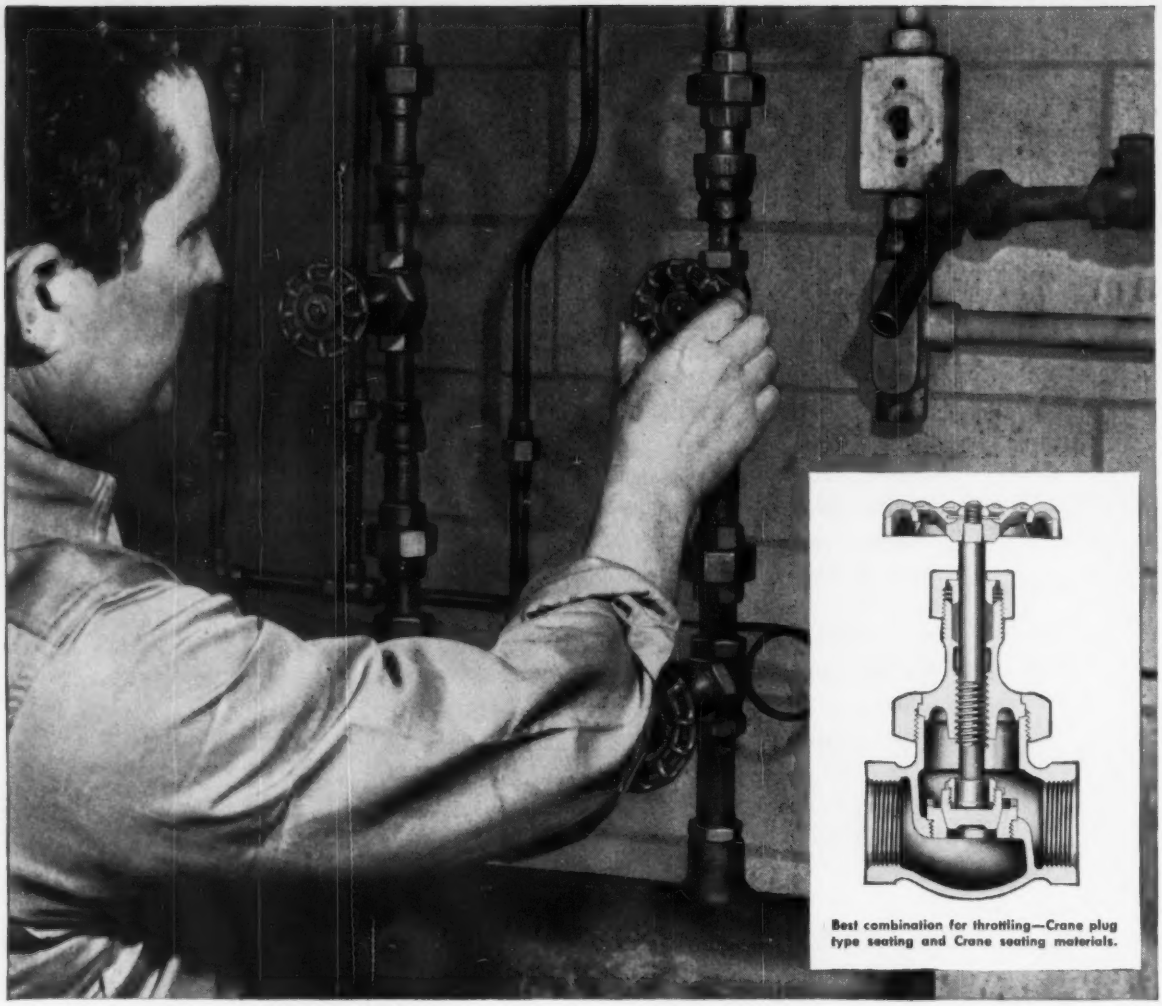
PLANT MAINTENANCE AND MANAGEMENT

Control manufacturers set up schools for instrument servicemen 113
Why not count your neighbors in on your disaster plans? 116
Take a look at honing—latest tool for producing superfinishes 118
Metallic packings are your best bet for gas compressors 120
Here's how fuel oil can be atomized with natural gas 123
Now—select the weather-protected motor housing best suiting your needs 124
Plant electrical fact file: Six stator-winding connections 126
Practical ideas 128 Plant problems 132
Comment 136 How to: solder with ultrasonics 138
Marmy tickles her ribs to solve a peak-load problem 140

READER SERVICE SECTION

Reports from the field 142 Technical briefs 144
Plant equipment news 148 George Edwards 152
New free literature: Yours simply for mailing the handy post cards provided 161

Print order this issue: 49,797



Best combination for throttling—Crane plug type seating and Crane seating materials.

Surprising savings for this power plant with Crane bronze throttling valves

At least once a year, this power plant of a leading machine tool builder was replacing the valves in the ½-inch continuous blowdown lines on its 60,000-pound boiler.

They were high-priced valves, but they couldn't take the continual throttling service. The seats cut out rapidly . . . blowdown regulation was lost . . . valve costs kept rising.

Thirty-one months ago this plant replaced the short-lived valves with Crane No. 212P, 200-pound bronze globe valves with plug type disc. Most of the time these Crane valves have been operating at less than half-open.

Yet, at every inspection to date, they've been found O.K.—no seat damage . . . no loss of regulation . . . no maintenance needed. Another proof of the economy of Crane quality!

To cut your valve and piping maintenance costs—on steam or any fluid—call in your local Crane Man. He has more to offer in money-saving piping materials.

COST-SAVING IDEAS FOR YOU in this free 36-page book of "Valve Performance Facts." Get your copy from your Crane Man or write to address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

In Canada: Crane, Limited, 1170 Beaver Hall Square, Montreal, Que.

L N ROWLEY — *Publisher and Editor*

B G A SKROTZKI — *Design and Application*
S M ELONKA — *Maintenance and Management*
J J O'CONNOR — *Managing Editor*
R C BELLAS — *Assistant Editor*
J W FOLLANSBEE — *Assistant Editor*
R H MARKS — *Assistant Editor*
N PEACH — *Assistant Editor*
A P SOMMER — *Assistant Editor*
L E STEWART — *Assistant Editor*
A S THORNTON — *Assistant Editor*
C F MARSCHALEK — *Art Editor*
F A ANNETT — *Contributing Editor*

DOMESTIC NEWS BUREAU: Atlanta, Chicago, Cleveland, Dallas, Detroit, Los Angeles, San Francisco, Seattle, Washington, D. C.
WORLD NEWS OFFICES: Beirut, Bonn, Caracas, London, Mexico City, Paris, Tokyo

CLARK BOUGHTON — *Sales Manager*

DISTRICT MANAGERS

ATLANTA 3, GA. – M H Miller, 801 Rhodes-Haverty Building, Walnut 5778
BOSTON 16, MASS. – J E Dean, 350 Park Square Building, Hubbard 2-7160
CHICAGO 11, ILL. – L W Romigh and G L Crane, 520 North Michigan Avenue, Mohawk 4-5800
CLEVELAND 13, OHIO – R E Heisserman, 55 Public Square, Superior 1-7000
DALLAS 1, TEXAS – E E Schirmer, The Vaughn Building, Prospect 5064
DENVER 2, COLO. – J W Patten, U. S. National Bank Building, 1740 Broadway, Alpine 5-2981
DETROIT 26, MICH. – L W Romigh, 856 Penobscot Building, Woodward 2-1793
LOS ANGELES 17, CALIF. – R H Antles, 1125 West Sixth Street, Huntley 2-5450
NEW YORK 36, N. Y. – W R Klein and J E Dean, 500 Fifth Avenue, Oxford 5-5959
PHILADELPHIA 3, PA. – C R Long, Six Penn Center Plaza, Locust 8-4330
PITTSBURGH 22, PA. – R E Heisserman, 1111 Oliver Building, Atlantic 1-4705
ST. LOUIS 8, MO. – G L Crane, Continental Building, 3615 Olive Street, Jefferson 5-4867
SAN FRANCISCO 4, CALIF. – R C Alcorn, 68 Post Street, Douglas 2-4600
LONDON E.C. 4, ENGLAND – B H Butler, McGraw-Hill Company Ltd, 95 Farringdon Street

W K PONDER — *Circulation Manager*

Power • August 1958 • Vol. 102—No. 8

speaking of Power

Many economists think the years between now and 1961 are middle years between two booms. This does not mean a long period of recession, but rather a time of slower growth. It may be likened to a transition from the postwar boom, based on deferred demand, to a new boom in the 1960's based solidly on our dynamic population growth and a major revolution in technology. If so, this is the time to prepare for the growth that lies ahead.

With this important job of preparing now for the 1960's facing all readers, POWER is devoting the complete October issue to the single theme of plant design and modernization. This special issue will assemble in one package a wealth of detail on new and modernized power-service facilities. It will summarize trends and describe pace-setting installations, while highlighting practical plant-design ideas.

The October issue will be made up of three major packages relating to *industrial plants, central stations, available design aids*. In opening up the issue you will first see the industrial-plant package. It will contain a design-feature survey of new and modernized industrial plants, including both steam-generation and in-plant electrical-distribution facilities. You will also find here an overall description of contemporary plant designs plus a roundup of forward-looking power-service features.

Same editorial elements will tell the story of advances in central stations: survey . . . graphic summary . . . description of top-drawer design in central stations . . . roundup of novel yet thoroughly practical design ideas.

Third and final section of this significant issue will wrap up a unique review and preview of new equipment and new design aids. Look upon them as tools to carry out your ideas.

This October issue is POWER's contribution to the McGraw-Hill *PLAN '59* editorial program beamed at showing how industry and all America can benefit by modernization and improvement of plant and equipment. For details on this program turn to pp 156-157.

Lon Rowley

POWER (with which are consolidated *Science and Industry, The Engineer Review, The Engineer, The Stationary Engineer* and *Operating Engineer*) is published monthly by McGraw-Hill Publishing Company, Inc, James H McGraw (1860-1948), Founder. PUBLICATION OFFICE: McGRAW-HILL BUILDING, 330 W 42nd St, New York 36, N. Y. See panel below for directions regarding subscriptions or change of address.

EXECUTIVE, EDITORIAL, CIRCULATION and ADVERTISING OFFICES: 330 W 42nd St, New York 36, N. Y. Donald C McGraw, President; Joseph A Gerardi, Executive Vice-President; L Keith Goodrich, Vice-President and Treasurer; John J Cooke, Secretary; Nelson Bond, Executive Vice-President, Publications Division; Ralph B Smith, Vice-President and Editorial Director; Joseph H Allen, Vice-President and Director of Advertising Sales; A R Venezian, Vice-President and Circulation Coordinator.

Subscriptions are solicited only from executives, engineers and supervisory personnel engaged in design, operation and maintenance of the power and plant services in utilities, consulting and contracting firms, industrial and service plants. Position and company connection must be indicated on subscription orders. Send to address shown in box.

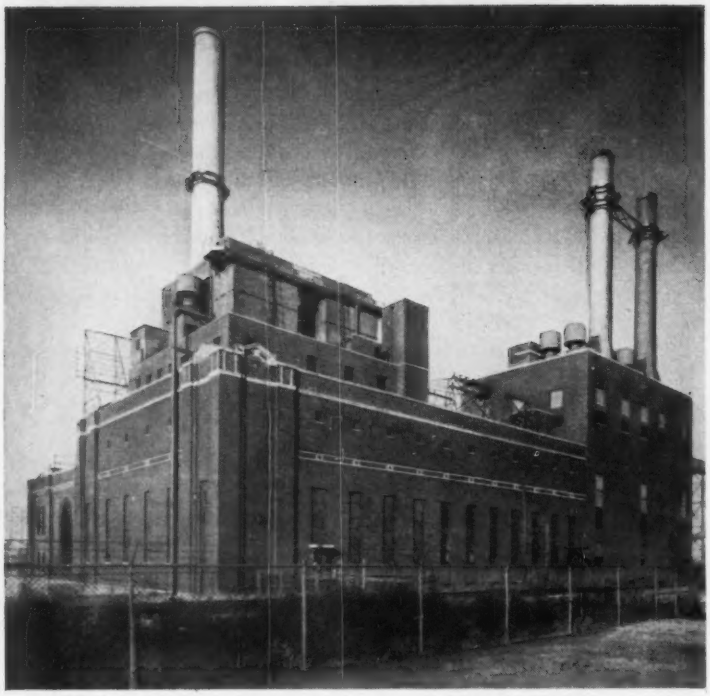
United States subscription rate for individuals in the field of the publication $5.00 per year, single copies $1.00, unless otherwise indicated. Canada; $7.00 for one year. Foreign; $15.00 for one year. Second-class mail privileges authorized at New York, N. Y. Printed in U.S.A. Title registered in U.S. Patent Office. ©. Copyrighted 1958 McGraw-Hill Publishing Company, Inc, all rights reserved.

UNCONDITIONAL GUARANTEE: Our primary aim is to provide subscribers with a useful and valuable publication. Your comments and suggestions for improvement are encouraged and will be most welcome. The publisher, upon written request from any subscriber to our New York office, agrees to refund the part of the subscription price applying to copies not yet mailed.

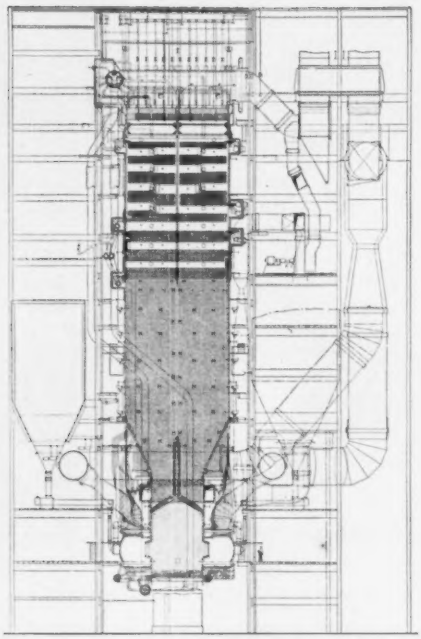
Power articles are indexed in both the *Industrial Arts Index* and the *Engineering Index*. POWER publishes its own annual index, obtainable on request to the Editor. Notice of availability appears in POWER.

SUBSCRIPTIONS: Send subscription correspondence and change of address to Fulfillment Manager, POWER, 330 W 42nd St, New York 36, N. Y. Subscribers should notify Fulfillment Manager promptly of any change of address, giving old as well as new address, and including postal zone number, if any (Official Post Office request). If possible, enclose an address label from a recent issue of the magazine. Since copies are addressed one to two issues in advance, please allow one month for change of address to become effective.

Postmaster: Send form 3579 to POWER, 330 W 42nd St, N. Y. 36, N. Y.



On the line for eight years at Commonwealth Edison Company's Joliet Station, 2 B&W Cyclone Furnace Boilers produce 1,200,000 pounds of steam per hour.



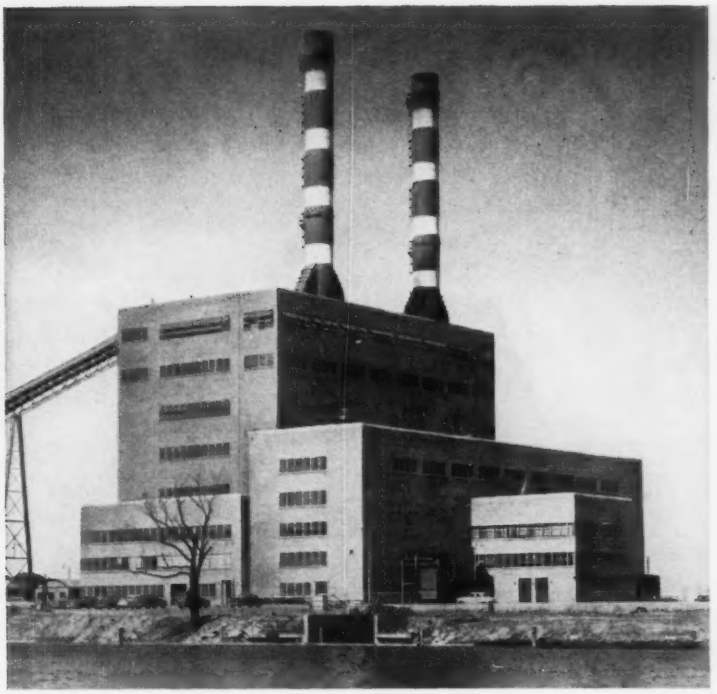
New Cyclone Furnace unit under construction for Joliet Station will generate 2,200,000 pounds of steam per hour. It will burn highly volatile Central Illinois coal with a high ash content and low ash-fusion temperature.

Proof in Action Means Continued Acceptance for B&W Cyclone Furnaces

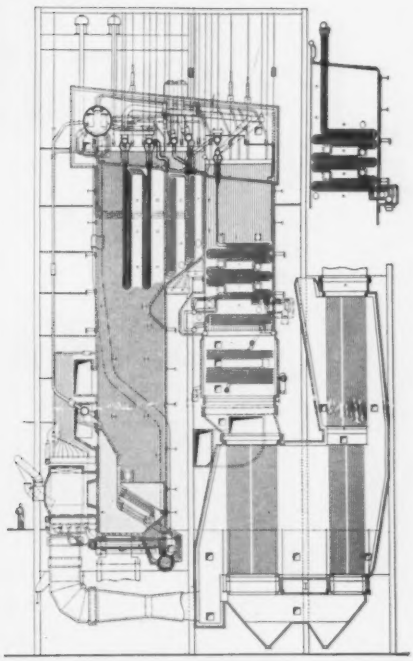
ON-LINE UNITS PROVIDE MODERN MEANS OF BURNING FUEL ECONOMICALLY

In installation after installation, the efficiency, economy and simple operation of B&W Cyclone Furnaces have led to continued acceptance. At the Commonwealth Edison Company, where the first Cyclone Furnace was installed in 1944, 14 additional units are in operation with still another on order. And at Wisconsin Power and Light Company's Edgewater Station, a Cyclone-Fired Boiler achieved such an outstanding record that B&W Cyclone Furnaces were also specified for that Company's Rock River and Nelson Dewey Stations.

The B&W Cyclone Furnace simplifies the entire process of coal preparation, combustion, ash handling and ash segregaton. Its cost-saving quality contributes to lower fuel costs and re-



Rock River Station of Wisconsin Power and Light Company. Six B&W Cyclone Furnaces fire 2 B&W Boilers to produce 1,050,000 pounds of steam per hour.



New unit for Wisconsin Power and Light's Nelson Dewey Station will use a B&W Cyclone Furnace to fire boiler producing 700,000 pounds of steam per hour.

duced maintenance as well as increased operational simplicity, flexibility and safety. Recognition of these facts is attested by the 77 Cyclone Furnace Boilers now either in service or under construction throughout the country.

Many other modern advances in combustion and high-pressure, high-temperature steam generation are also available through B&W. They merit examination in connection with your next installation. Write for further information to The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

PURCHASERS OF THE B&W CYCLONE FURNACE

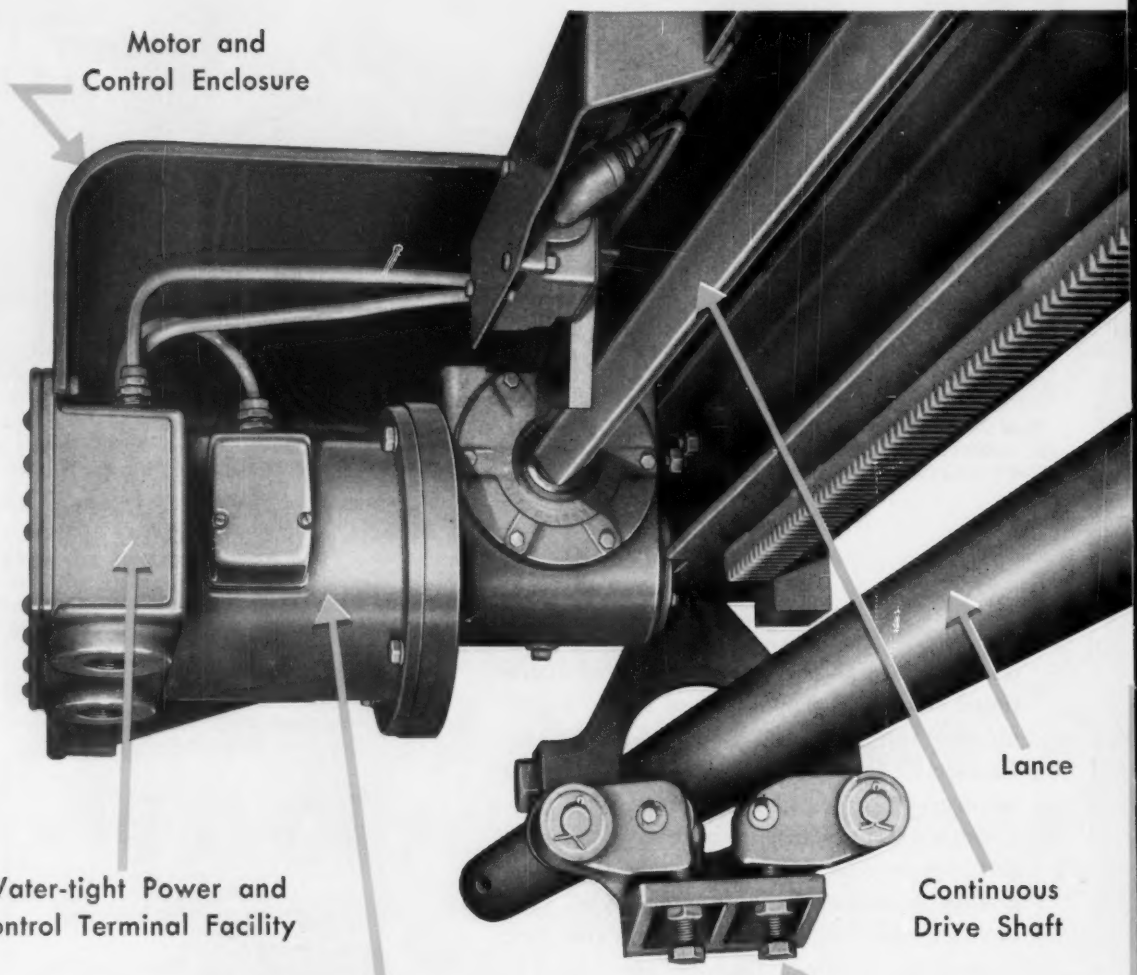
FOR CENTRAL POWER STATIONS	Number of Cyclone Furnace Boilers
Atlantic City Electric Co.	1
Baltimore Gas & Electric Co.	1
Chilena de Electricidad	2
Columbus & Southern Ohio Electric Co.	2
Commonwealth Edison Co.	16
Consumers Public Power District (Nebraska)	1
Detroit Edison Co.	1
Indiana & Michigan Electric Co.	1
Jersey Central Power & Light Co.	3
Memphis Light, Gas & Water Division	3
Middle South Utilities, Inc.	1
Missouri Public Service Company	2
Monongahela Power Co.	1
Northern Indiana Public Service Co.	3
Ohio Edison Co.	2
Ohio Power Co.	6
Public Service Co., of New Hampshire	1
Tampa Electric Co.	3
United Illuminating Co.	2
Wisconsin Power & Light Co.	4
FOR INDUSTRIAL INSTALLATIONS	
American Cyanamid Co.	1
American Enka Corp.	1
Clinton Corn Processing Co., Division of Standard Brands	1
Columbia Southern Chemical Co.	1
Consolidated Water Power & Paper Co.	1
Dow Chemical Co.	5
Eastman Kodak Co.	1
Greenwood Mills	1
International Paper Co.	4
National Container Corp., of Wisconsin	1
Rhinelander Paper Co.	1
St. Croix Paper Co.	1
Thilmany Pulp & Paper Co.	1
West Virginia Pulp & Paper Co.	1
Total	**77**

BABCOCK & WILCOX

BOILER DIVISION

G-887

FRONT END



Single Enclosed Motor for both propulsion and rotation

Motor mounted at boiler end for improved accessibility and better protection from physical damage and elements.

(Outboard end motor mounting optional)

Single-Motor DRIVE

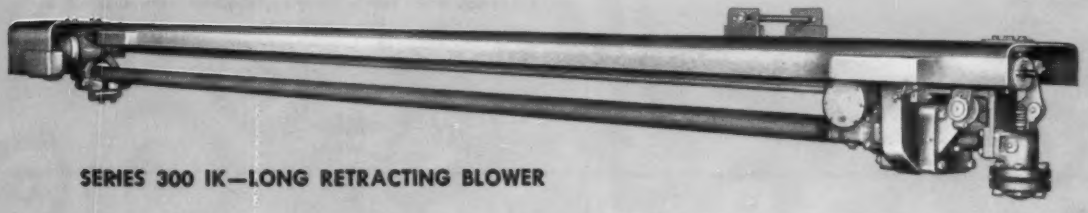
another important feature of

New **Diamond**

Series 300 IK
LONG RETRACTING BLOWER

As illustrated at the left, only one *motor* is used to simultaneously propel and rotate the lance tube of the new Series 300 IK. The motor is stationary and is mounted at the boiler wall for easier accessibility and greater protection from physical damage and the elements (note the protective enclosure). This front end single-motor drive is simple and dependable. There is only one set of motor elements . . . one set of control elements . . . and one set of power supply facilities to operate and maintain.

Additional important features of the new Series 300 IK are listed in the panel below. Check them and you will understand why this blower is establishing a new standard of efficiency, economy and dependability in cleaning those heating surfaces that require a long retracting blower. For further information about the new Series 300 IK, ask your local Diamond office or write directly to Lancaster for Bulletin 2111U.



SERIES 300 IK—LONG RETRACTING BLOWER

OTHER ADVANTAGES OF SERIES 300 IK BLOWERS

- Backbone and Protective Cover
- Compact, Accessible Electric Power and Control Terminal Facilities
- Nozzle-Sweep-Every-Inch Cleaning Pattern
- Improved "Type A" Nozzle
- Positive Gear Carriage Drive
- Poppet Valve with Adjustable Pressure Control
- Positive Mechanically Operated Valve
- Single Point Outboard Suspension
- Oversize Lance (Step-Tapered for Extra Long Travel)
- Auxiliary Carriages for Extra Long Travel
- Designed for Quick, Easy Servicing

No other blower gives you all these advantages.

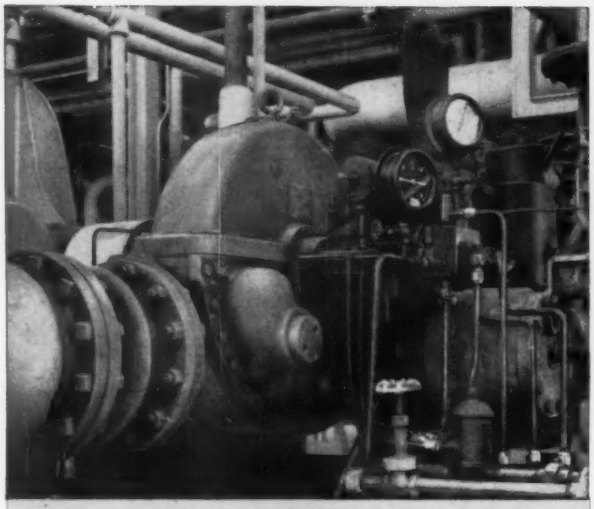
Diamond **DIAMOND POWER SPECIALTY CORPORATION**

LANCASTER, OHIO

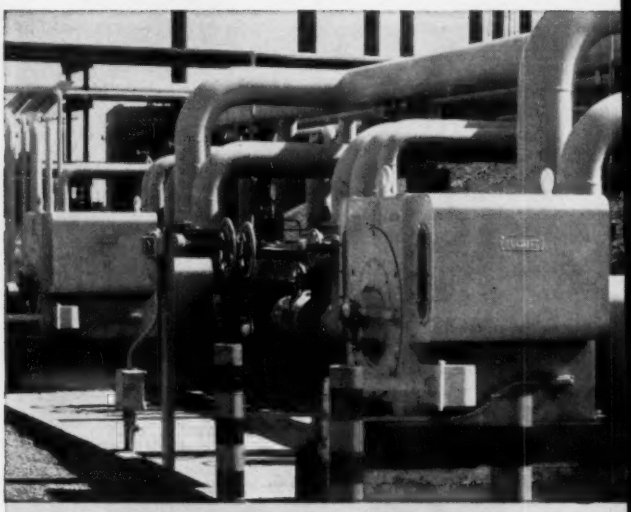
Diamond Specialty Limited
Windsor, Ontario

8083

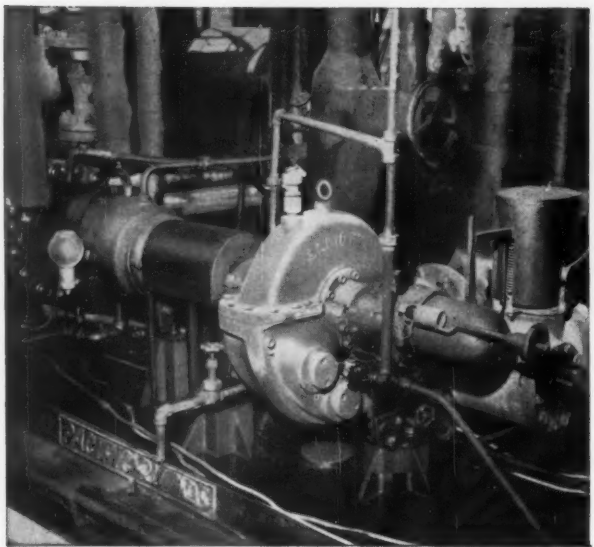
ELLIOTT serves



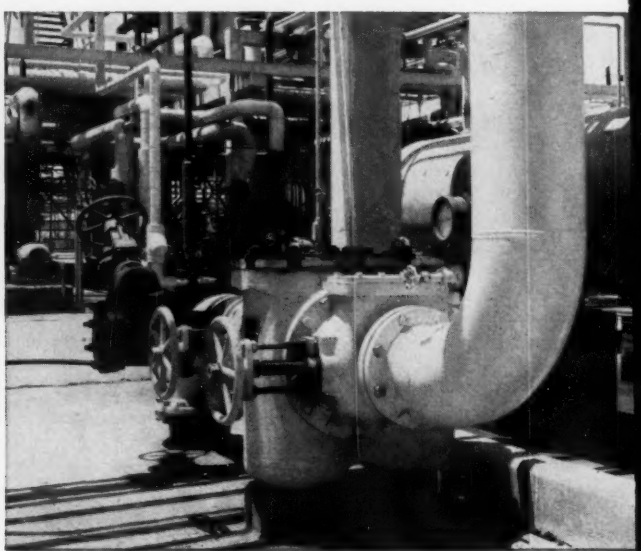
This Elliott 370-hp, 3240-rpm steam turbine drives a reciprocating compressor through a gear. The compressor serves a hydroformer unit.



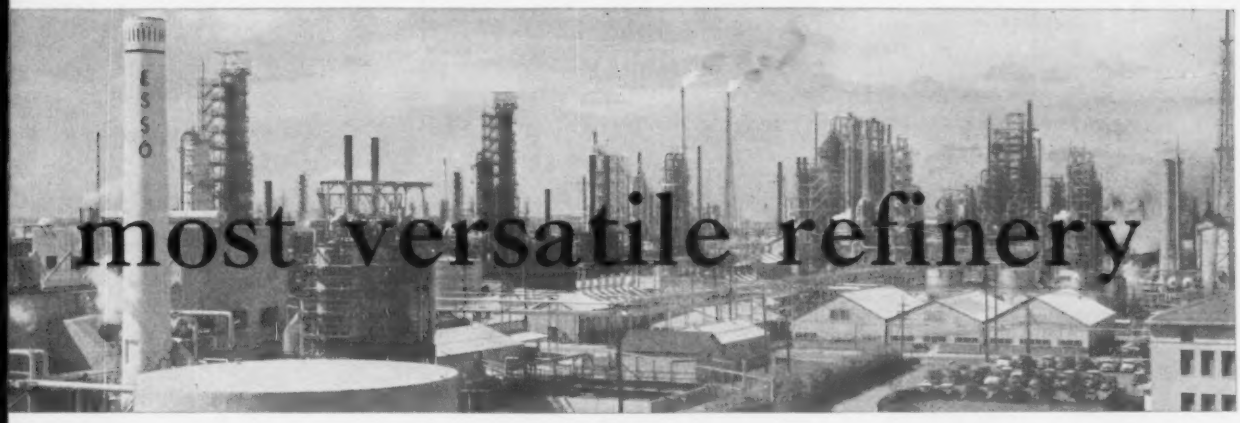
These two Elliott 450-hp weather-protected outdoor motors, located in the bluff area near the docks, are used to drive centrifugal pumps which handle heavy naphtha from adjacent tankage.



One of eleven Elliott turbines driving centrifugal pumps at a lube oil unit.



Here an Elliott 8-in. twin strainer handles river water at a lube oil unit.

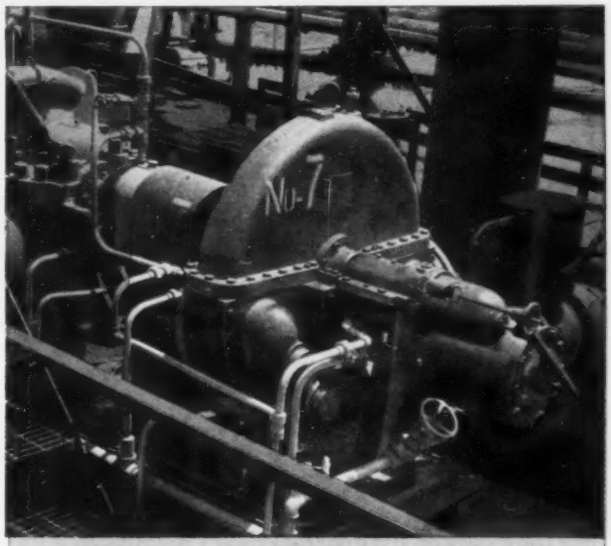


Esso Standard's Baton Rouge Refinery—producing more products than any other—is served by Elliott Turbines, Motors, Twin Strainers, Steam Ejectors, Deaerating Heaters

When this Esso Standard Oil Company refinery started operations in 1909, it processed 2000 barrels of crude oil per day into only three products. Now it converts 340,000 barrels of crude oil per day into over 600 products—a world's record in respect to number of products. It is also rated the largest refinery in the United States based on crude running capacity.

More than 100 Elliott steam turbines, ranging in size from 7 to 900 hp, are used in this refinery to drive all sorts of pumps, fans and compressors. Over a score of Elliott twin strainers, sizes 2 in. to 24 in., and Elliott steam jet ejectors serving vacuum units have been installed. Elliott 300-hp, 400-hp, and 450-hp motors are driving pumps and an Elliott 1750-hp, 1800-rpm induction motor is driving a centrifugal gas compressor. There are also four Elliott deaerating feedwater heaters.

Here is another dramatic illustration of how highest-quality steam and electrical products, manufactured by Elliott, serve leading industries. For information on how Elliott products can help you, call your nearby Elliott District Office or write Elliott Company, Jeannette, Pa.

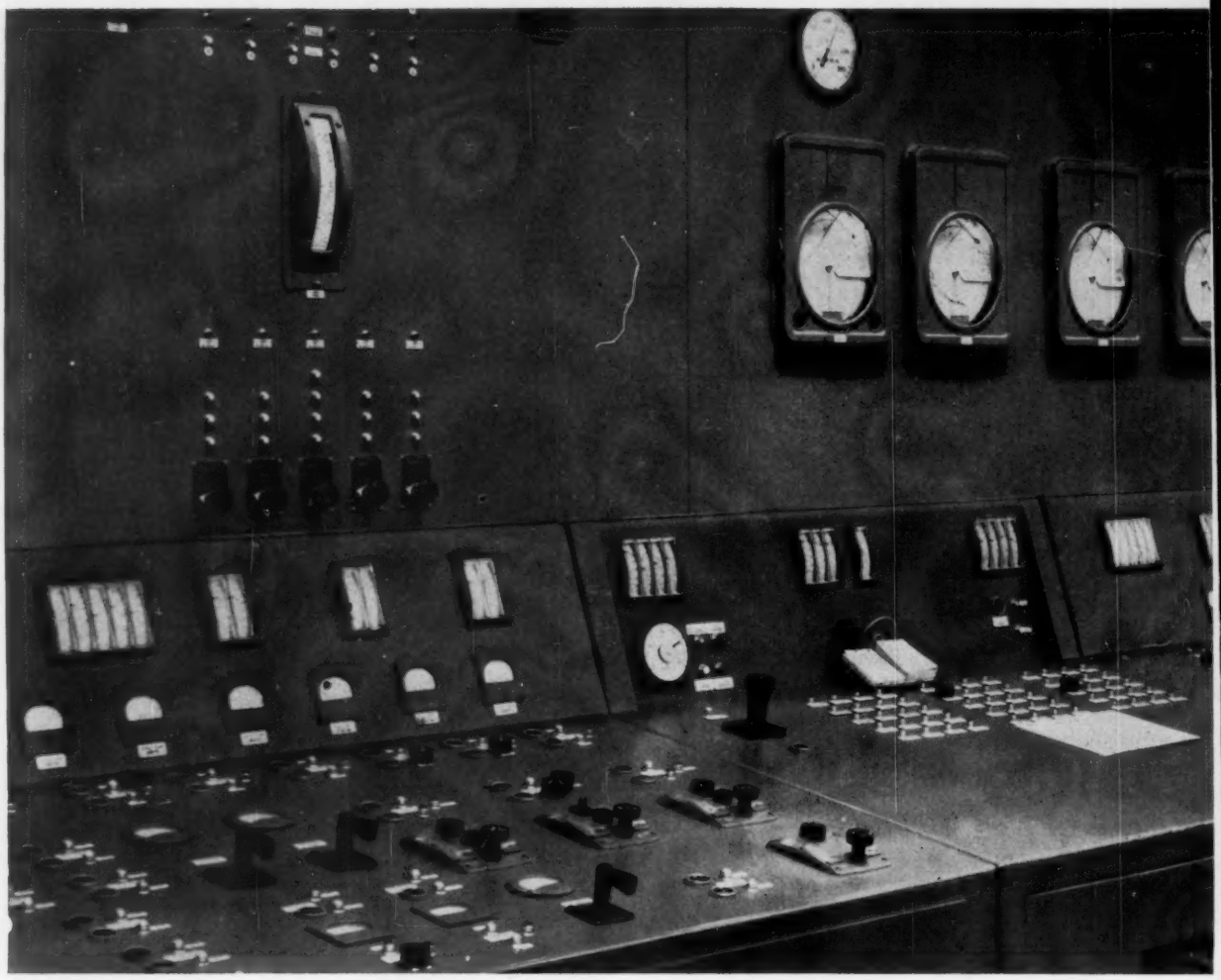


Elliott Turbines, **from small single-stage to large multi-stage types, assure highest-quality, long-term continuous service. This typical installation, operating on a 24-hour-a-day basis, is a 460-hp, 1750-rpm Elliott turbine which drives a river water booster pump. Bulletin H-22B describes the features which have resulted in the widespread use of Elliott YR turbines.**

ELLIOTT Company

Q7-1

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL COMPRESSORS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS



Why Bailey is the choice of America's

Take the top six on the Federal Power Commission's heat rate report. All use Bailey Meters and Controls. Five of the six chose Bailey *exclusively!*

Coincidence? Let's take a *larger* sample. Out of the top 46 "most efficient" power plants listed, 38 use Bailey products. Here's why:

1. A Complete Line of Equipment

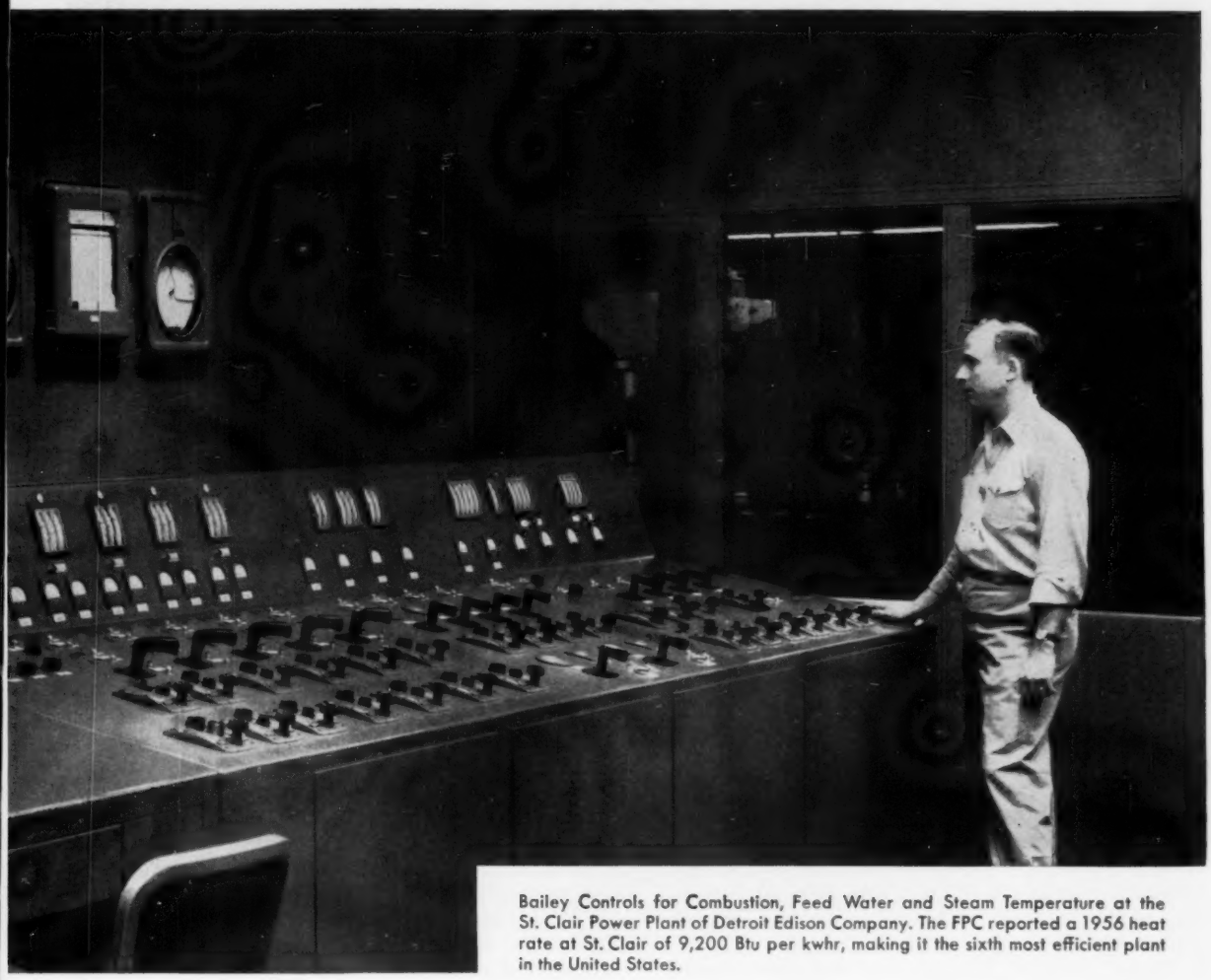
You can be sure a Bailey Engineer will offer the right combination of equipment to fit your needs. Bailey manufactures a complete line of standard, compatible pneumatic and electric metering and control equipment that has proved itself. Thousands of successful installations involving problems in measurement, combustion, and automatic control are your assurance of the best possible system.

2. Experience

Bailey Engineers have been making steam plants work efficiently for more than forty years. Veteran engineer and new engineer alike, the men who represent Bailey are storehouses of knowledge on measurement and control. They are up-to-the-minute on the latest developments that can be applied to your problem.

3. Sales and Service Convenient to You

There's a Bailey District Office or Resident Engineer close to you. Check your phone book for expert engineering counsel on your steam plant control problems.



Bailey Controls for Combustion, Feed Water and Steam Temperature at the St. Clair Power Plant of Detroit Edison Company. The FPC reported a 1956 heat rate at St. Clair of 9,200 Btu per kwhr, making it the sixth most efficient plant in the United States.

MOST EFFICIENT* STEAM PLANTS!

***6 MOST EFFICIENT PLANTS**

1956 Heat Rates Reported by FPC

	Btu/kwhr	Meters	Combustion Control	Feed Water Control	Supht. Control
1. Tanners Creek (Indiana and Michigan Electric Company) .	9,106	B	B	B	B
2. Kanawha River (Appalachian Electric Power Company). .	9,115	B	B	B	B
3. Kyger Creek (The Ohio Power Company)	9,176	B		B	B
4. Muskingum River (The Ohio Power Company).	9,176	B	B	B	B
5. Clifty Creek (Indiana-Kentucky Electric Company).	9,200	B	B	B	B
6. St. Clair (The Detroit Edison Company)	9,200	B	B	B	B

B—Bailey Equipment

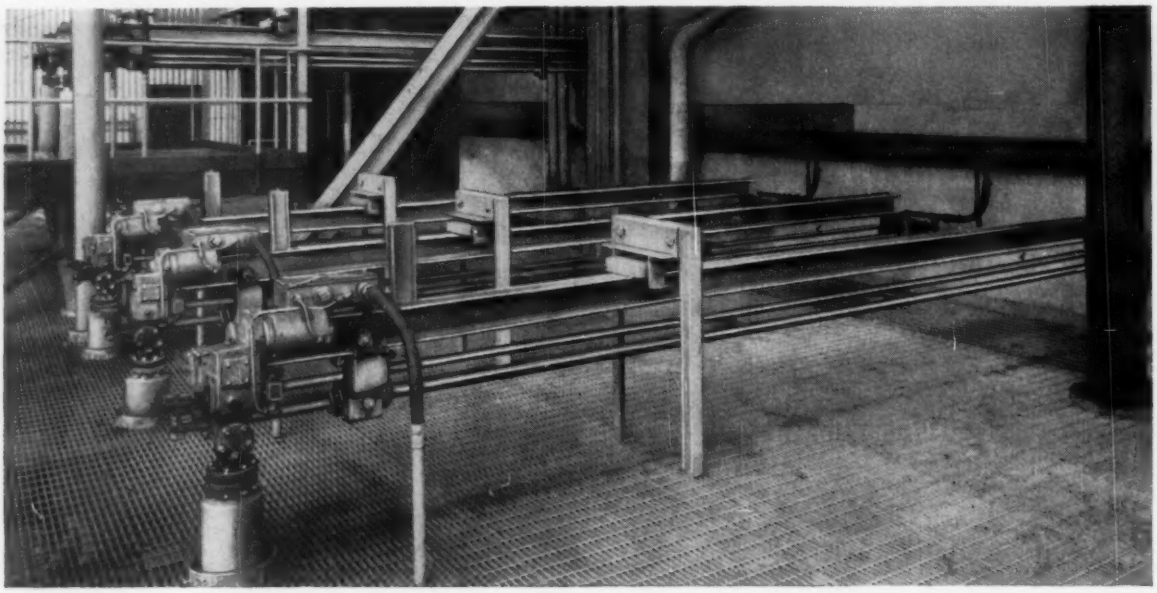
A140-2

Instruments and controls for power and process

BAILEY METER COMPANY

1036 IVANHOE ROAD • CLEVELAND 10, OHIO

In Canada—Bailey Meter Company Limited, Montreal



Vulcan Automatic-Sequential System controls soot blowing at new Gannon Station

As the first modern utility boiler in Florida to be fired by coal, Tampa Electric Company's Gannon Station incorporates the most advanced control systems. Unit 1, with its boiler rating at 950,000 pounds per hour at 1760 psig and 1000 degrees F., uses a Vulcan soot blowing system that features both group and unit control.

Vulcan T-3-E long retractable soot blowers with their dual-motor drives clean Gannon's Unit 1 boiler with double-helix patterns for complete coverage. The system includes Vulcan wall deslaggers and rotary soot blowers—all driven by electric motors and using steam as the blowing medium. A Copes-Vulcan diaphragm valve reduces steam pressure for blowing and a Copes-Vulcan motor-operated valve is used for shut-off.

A similar Vulcan system will be installed on Gannon's Unit 2, rated at 950,000 pounds per hour at 1760 psig and 1000 degrees F.

Besides fully-automatic soot blowing systems, Copes-Vulcan offers complete systems for controlling combustion, feedwater, boiler feed pump recirculation, and steam temperature. Whether your boiler is large or small, power or process, Copes-Vulcan can provide a unit or an integrated package, custom designed to your requirements.

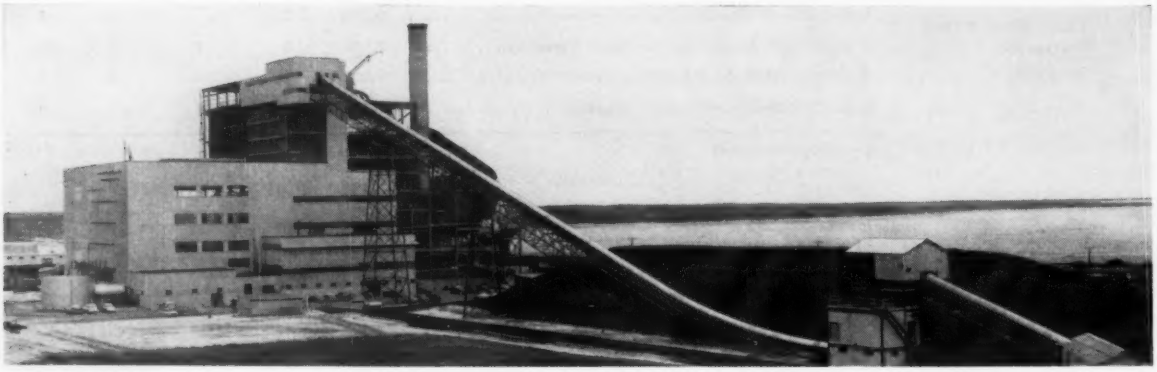
COPES VULCAN

Copes-Vulcan Division

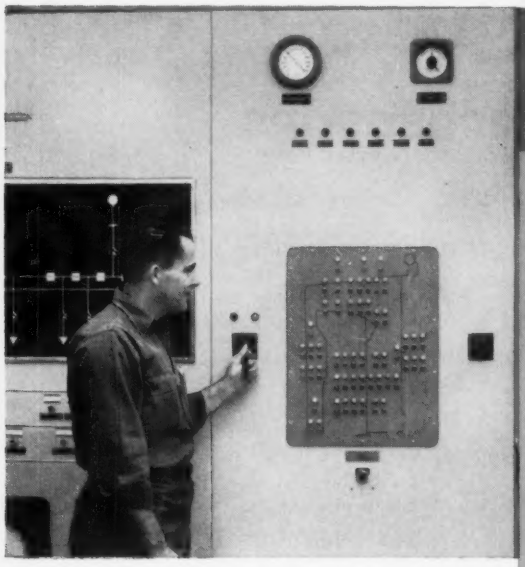
BLAW-KNOX COMPANY

Erie 4, Pennsylvania

BLAW-KNOX

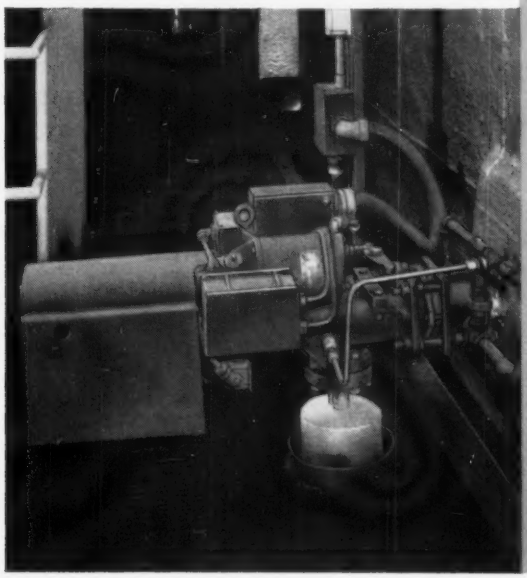


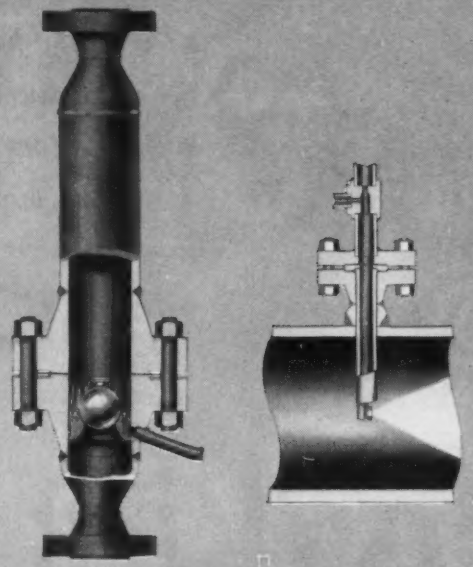
C-V NEWS NOTES



Finger tip control for Gannon's operators . . . with Vulcan's Automatic-Sequential group and unit control. Operator can preselect any number of soot blowers for automatic sequence . . . preselect any number of units or groups of units to be operated individually . . . or switch instantly to single unit operation. Program lights and toggle switches are located on engraved boiler diagram. Automatic-Sequential systems use steam, air or a combination as the blowing medium without a change in equipment. Write for Bulletin 1029.

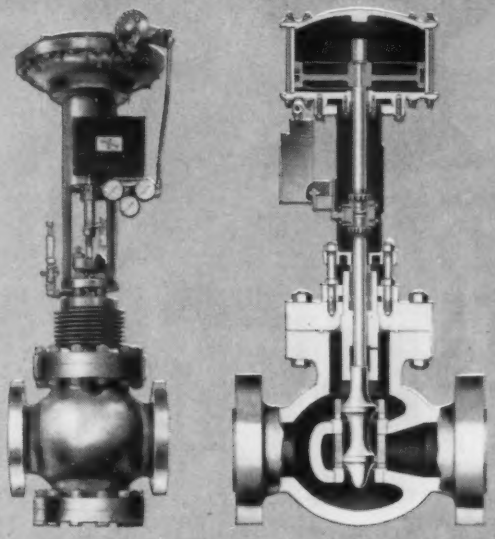
Wall deslagger conserves steam . . . minimizes average slag thickness. Vulcan's RW-3E is equipped with dual motors: one to traverse *fast* to get the nozzle to and from the blowing position almost instantly . . . the other to rotate the tube slowly for thorough cleaning. The RW-3E may be installed indoors or out, at almost any angle from side wall, roof or floor. It has only one outside stuffing box, no threads or working parts in the blowing medium to assure easy maintenance. Write for Bulletin 1034.





Desuperheaters improve temperature control. Variable-Orifice Desuperheater* (left) uses a weighted steel ball to control orifice opening . . . holds reduced steam temperature constant only twenty feet downstream from desuperheater outlet, even over a 50-to-1 load range. Bulletin 1037. *Patent Applied For

Steam-Assist (right) meets all specifications for conventional steam-atomizing type yet normally uses assisting steam only on light loads where control is most difficult. Mechanical-atomizing types also available. Bulletin 1024-A.



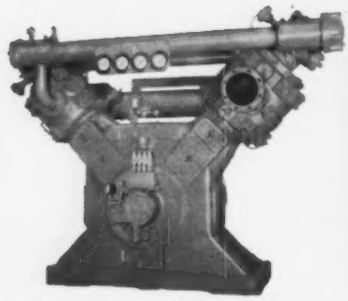
Versatile regulator valves offer new simplicity of design. Diaphragm-type CV-D (left) is designed for remote control service. It can be direct or reverse acting, has excellent rangeability. Piston-type CV-P (right) is designed for high-duty service . . . assures maximum power with precise positioning.

All Copes-Vulcan valves are tailored to the job. The style of valve port is selected to provide optimum control for specified operating conditions. Bulletin 1027.

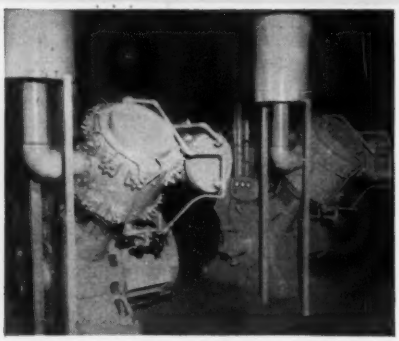
TYPE Y COMPRESSORS

- *75 to 250 horsepower*
- *For vacuum service and pressures to 5,000 pounds*
- *One to four stages of compression*
- *Built-in motor, coupled, and belt drive*
- *Simple, compact, widely adaptable, heavy-duty*
- *Built for "round-the-clock service" with minimum of attendance*

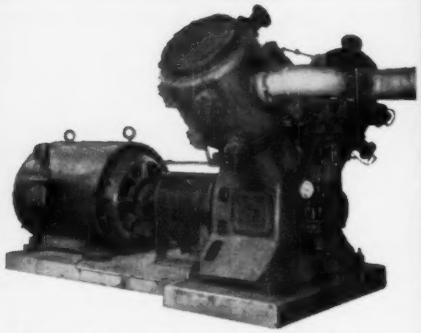
word for the Y's...



Four-stage high pressure unit available with flange-mounted, belted, or coupled drive.



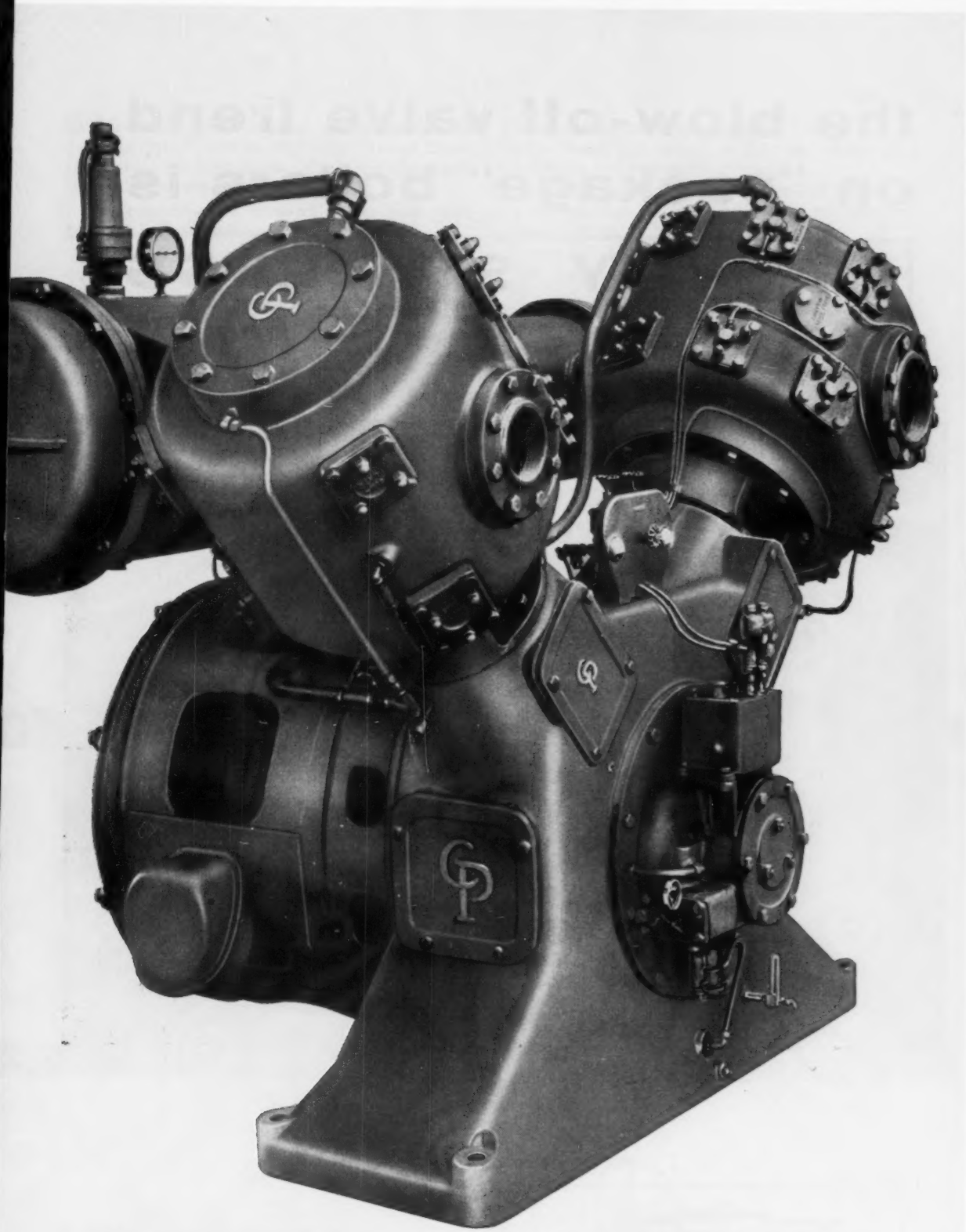
Non-lubricated, two-stage compressor, with built-in motor, provides oil-free air for process work.



Butane compressor, direct coupled to an explosion-proof motor, in a prominent refinery.

THEY'RE ADAPTABLE

★ OTHER TYPE COMPRESSORS AVAILABLE
IN SIZES TO 5000 HP AND PRESSURES TO 15,000 PSIG.

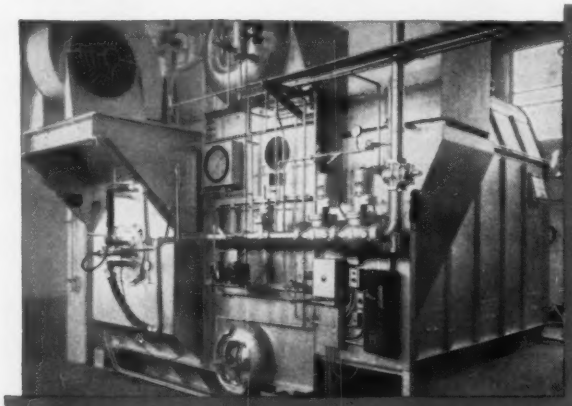


Chicago Pneumatic 8 East 44th Street, New York 17, New York

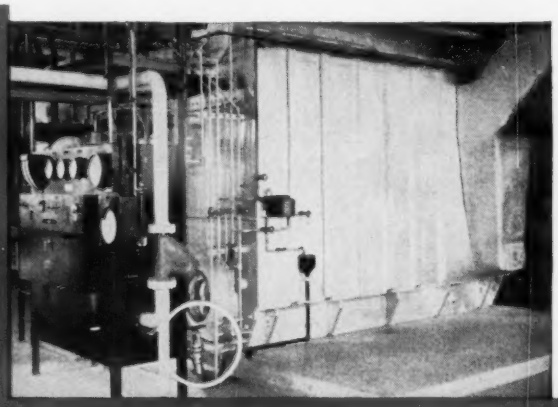
AIR AND GAS COMPRESSORS • VACUUM PUMPS • PNEUMATIC TOOLS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS

the blow-off valve trend on "package" boilers is

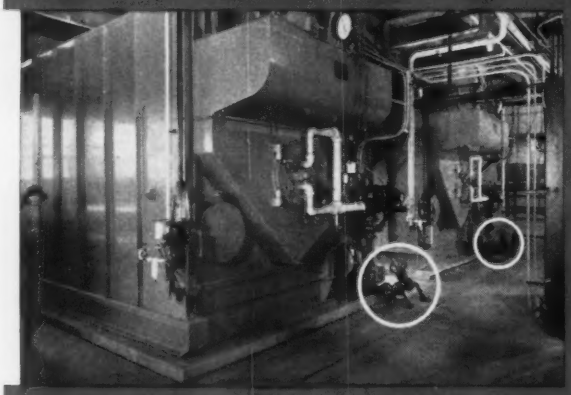
YARWAY SEATLESS



• E. KEELER



• COMBUSTION ENGINEERING



• TITUSVILLE

• KEWANEE-SPRINGFIELD

YARWAY® **BLOW-OFF**

■ More and more leading manufacturers of package-type boilers are featuring Yarway Blow-Off Valves on their units. Many are standardizing on Yarways.

The reason—good blow-off valves help good package boilers *perform better*.

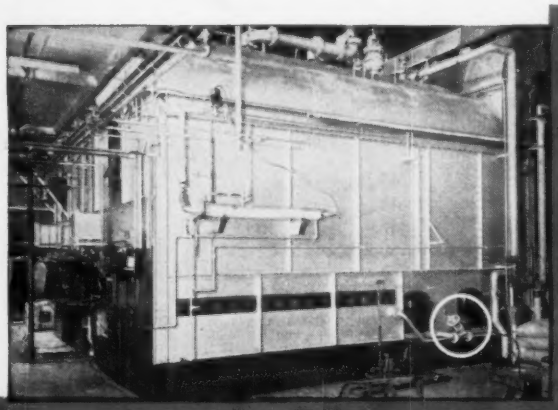
Yarway—known for nearly 50 years for *quality* blow-off valves—offers advanced design, dependable service, and reasonable cost . . . three features attractive to all boiler users.

The Yarway Seatless Blow-Off Valve, with balanced hollow sliding plunger and no seat to score, wear, clog or leak, is the most widely used valve for low and medium pressures.

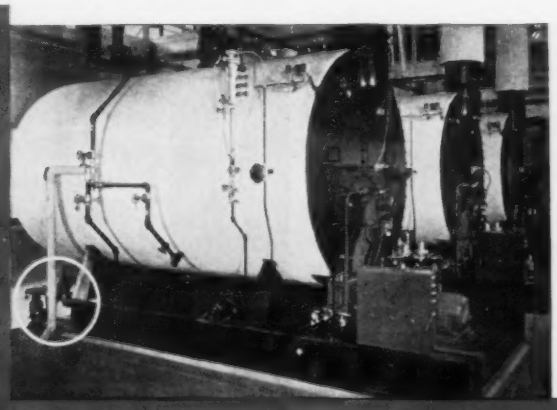
Specify Yarway Seatless Blow-Off Valves on your package boilers. All boiler makers will supply them.

For full description of Yarway Seatless Blow-Off Valves write for Yarway Bulletin B-426.

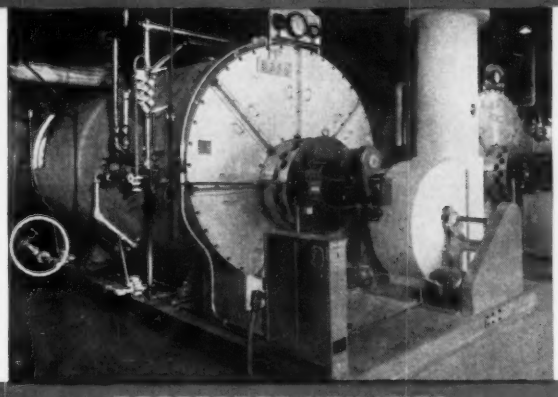
YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES



● ERIE CITY



● CLEAVER-BROOKS



● PREFERRED UTILITIES

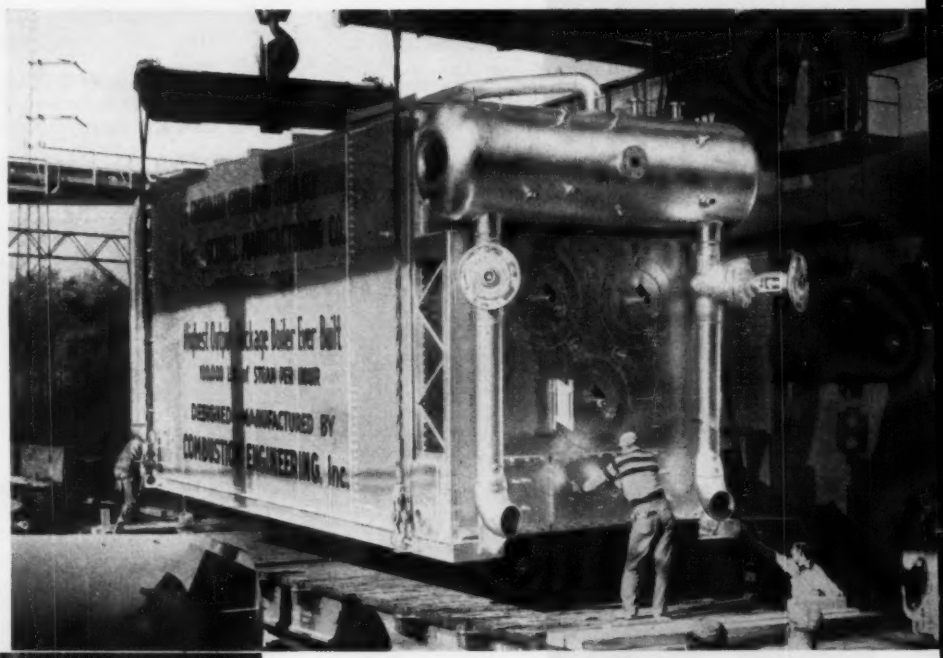
● **Yarway Seatless Tandem Blow-Off Valve** (angle-straightway combination) with angle valve sectioned to show balanced sliding plunger design.

● **Yarway Seatless Tandem Blow-Off Valve,** angle-angle combination, straightway-angle or straightway-straightway tandems also available.

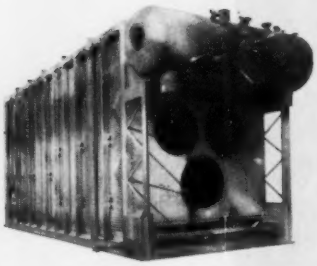
VALVES

Announcing THE C-E CONTROLLED

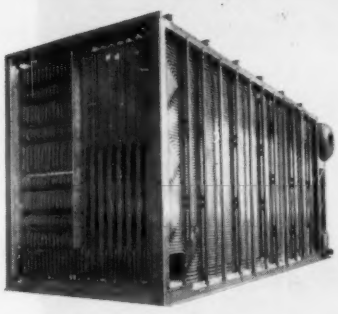
Another Combustion first in the boiler field — the type PCC package unit, utilizing controlled circulation. This one, being loaded at our St. Louis shops for delivery to Scovill Manufacturing Co., is the world's highest output package boiler, having a design capacity of 100,000 lb. of steam per hr. This picture illustrates the ease with which this new, high performance design can be readied for shipment. Its size permits transfer from railway siding to destination by truck.



Tubing arrangement—looking toward rear through burner opening.



Fabrication view of drum end of 100,000 lb. per hr. type PCC boiler. Three circular openings accommodate burners. Integral structure requires no outside support for boiler.



Rear view of type PCC points up superheater arrangement and complete waterwall construction of this boiler.

CIRCULATION PACKAGE BOILER

...Type PCC

A NEW HIGH PERFORMANCE DESIGN OFFERING

Capacities to 100,000 lb. per hr.
Pressures to 1,000 psi
Temperatures to 900 F.

Available for the first time to industrial steam users is C-E's famous controlled circulation design in a convenient package size. The oil or gas fired PCC offers capacities from 80,000 to 100,000 lb. per hr., pressures from 450 to 1000 psi, and temperatures to 900 F. Higher pressures and temperatures are obtainable if desired.

Seven PCC boilers are now in service. One of these is a special purpose design for steam conditions of 1500 psi and 1050 F.

The PCC is especially suitable where existing space is limited, yet high capacity, temperature, and pressure are required. It is only through the use of controlled circulation that such a compact, high performance unit could be built. This exclusive C-E design assures positive distribution and control of water to all circuits, permitting the PCC to be placed on the line faster than any natural circulation boiler. It also allows easy handling of rapid load swings with high quality steam production.

Not only does the PCC combine outstanding performance in a unit requiring minimum space, but also it offers the inherent advantages of package boiler design: quality shop assembly by experts, better delivery dates, much less plant disruption for installation and, of course, cost advantages due to these features.

If your future steam requirements call for a high performance boiler, it will pay you to investigate the PCC. It offers utility type boiler quality in a compact package along with the economy and reliability characteristic of C-E design.

THE PCC

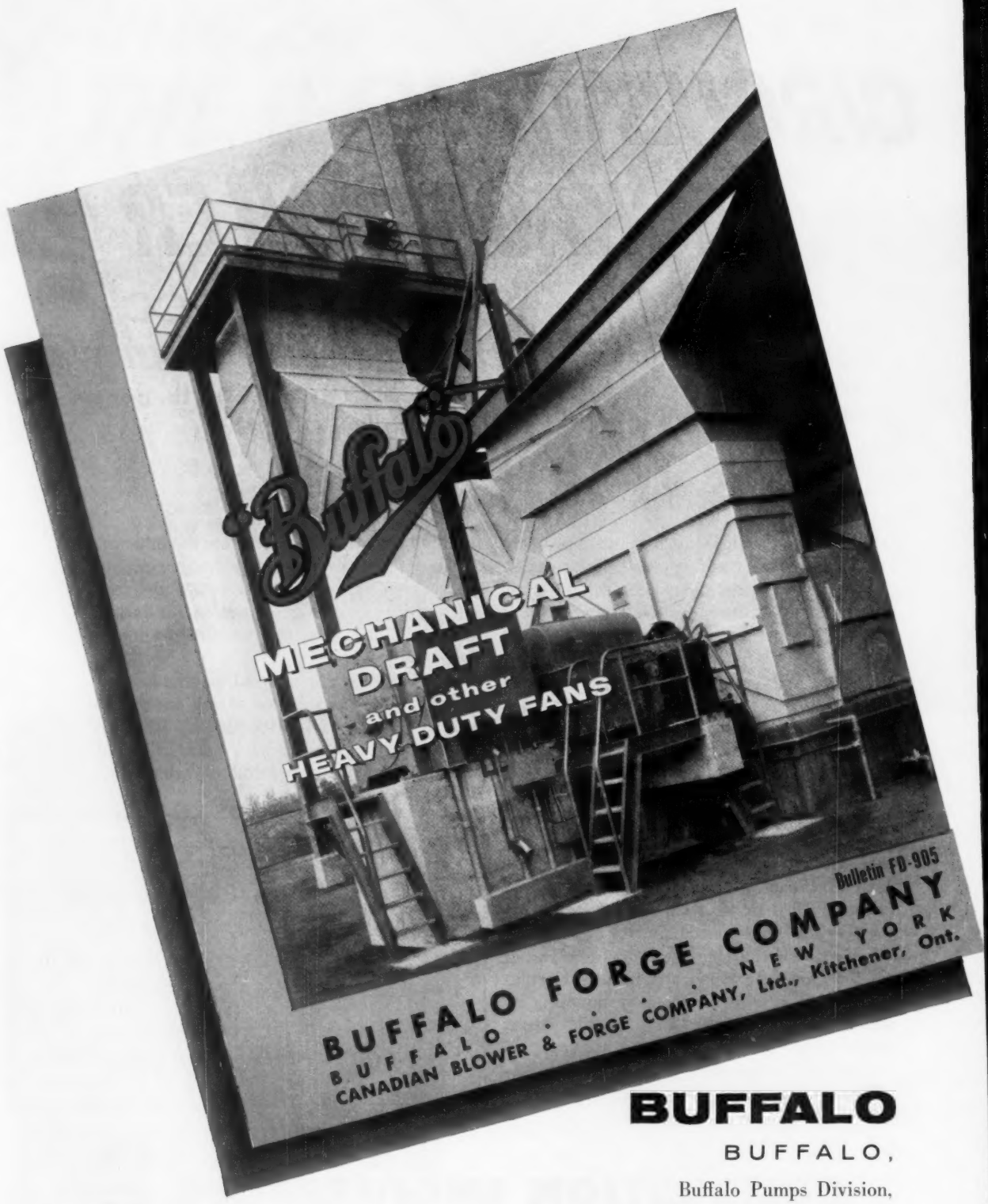
Meets these industrial steam needs	with these advantages
• Power generation—with or without process steam requirements.	• Controlled circulation
• High capacity, temperature, pressure.	• Quality shop fabrication
• Maximum generating capacity in limited space.	• Ease of shipment
	• Minimum plant down-time for installation
	• Earlier delivery than possible with field erection

COMBUSTION ENGINEERING

C-169

Combustion Engineering Building
200 Madison Avenue, New York 16, N.Y.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS; PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE



BUFFALO

BUFFALO,

Buffalo Pumps Division,

Canadian Blower & Forge Co.,

VENTILATING • AIR CLEANING • AIR TEMPERING • INDUCED DRAFT

CRITICAL DRAFT REQUIREMENTS ?
FILL THEM PRECISELY
WITH "BUFFALO" FANS !

Don't settle for a "Compromise Fan" ! You'll never need to, with a broad choice from the complete line of "Buffalo" mechanical draft fans. Described below are only two of the many types of "Buffalo" Fans designed to cover the full range of boiler requirements. Remember — when you specify "Buffalo" you can select a fan with the characteristics to match your pressure-volume needs — *exactly*.

"BUFFALO" TYPE "BLH" FAN

Does your installation call for a fan designed to deliver peak efficiency, economy and dependability for mechanical draft service? Then the "Buffalo" Type "BLH" Fan is your answer. Maintaining a high mechanical efficiency of 86% over a very broad operating range, the "BLH" provides constant stability of performance from free delivery to shutoff. Turbulence is minimized by unique design features including smooth inlet bell, directional inlet vanes, backward-curved blades, rotor flange curved to match inlet bell and the gradually divergent outlet. All these factors contribute to the smooth, powerful, quiet performance of the "Buffalo" Type "BLH" Fan.

"BUFFALO" AIRFOIL TYPE FAN

Where boiler operation indicates the desirability of using airfoil fans, with their high peaking efficiency, selection from the complete "Buffalo" airfoil line assures full benefits from this design. Every feature combines to attain a new high in quiet, efficient operation — the completely streamlined inlet — the true half-circle formed by the wheel flange and matching inlet bell — the low loss inlet box design. The cantilevered variable inlet vanes deep in the inlet throat, the advanced wheel design, scroll shape and divergent outlet also reduce turbulence to a minimum and add to peak performance. The net result brings you the most efficient fan yet offered for a wide range of pressures up to 85″, capacities over ½ million cfm.

Illustrated is the NEW "Buffalo" Mechanical Draft catalog covering forced draft, induced draft, primary air, gas recirculating, sintering fans and cyclone compressors. Descriptions cover rotors, shafts, housings, inlet boxes, variable inlet vanes, dampers, bearings, shaft seals, blade and scroll liners. If you would like to receive a copy, just send us a note on your company letterhead. Ask for Bulletin FD-905.

FORGE COMPANY

NEW YORK

Buffalo, New York

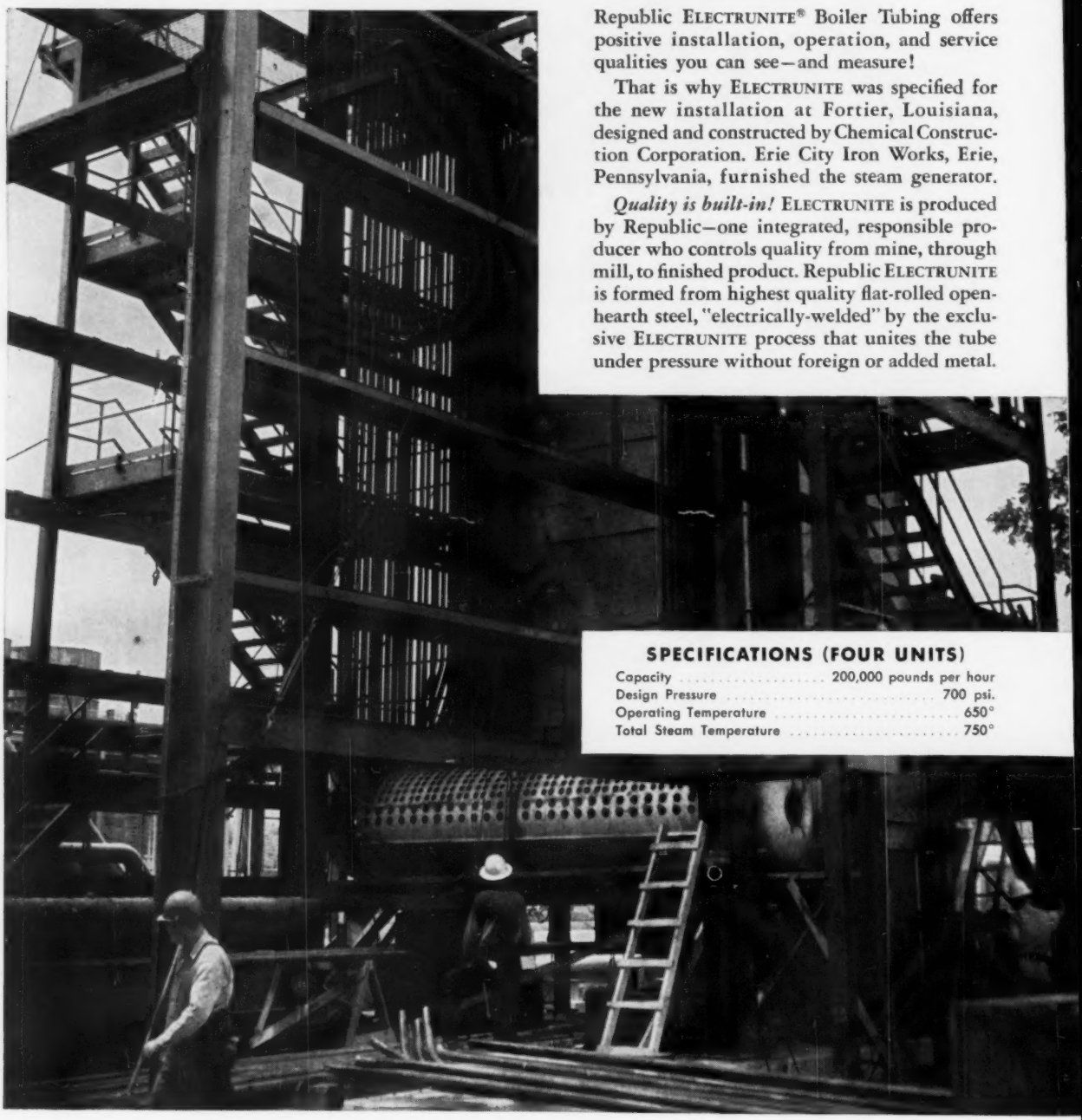
Ltd., Kitchener, Ontario

"Buffalo"

EXHAUSTING • FORCED DRAFT • COOLING • HEATING • PRESSURE BLOWING

Republic ELECTRUNITE offers QUALITY YOU CAN

ELECTRUNITE...installed at CHEMICO designed plant



Republic ELECTRUNITE® Boiler Tubing offers positive installation, operation, and service qualities you can see—and measure!

That is why ELECTRUNITE was specified for the new installation at Fortier, Louisiana, designed and constructed by Chemical Construction Corporation. Erie City Iron Works, Erie, Pennsylvania, furnished the steam generator.

Quality is built-in! ELECTRUNITE is produced by Republic—one integrated, responsible producer who controls quality from mine, through mill, to finished product. Republic ELECTRUNITE is formed from highest quality flat-rolled open-hearth steel, "electrically-welded" by the exclusive ELECTRUNITE process that unites the tube under pressure without foreign or added metal.

SPECIFICATIONS (FOUR UNITS)

Capacity	200,000 pounds per hour
Design Pressure	700 psi.
Operating Temperature	650°
Total Steam Temperature	750°

Boiler Tubing

MEASURE

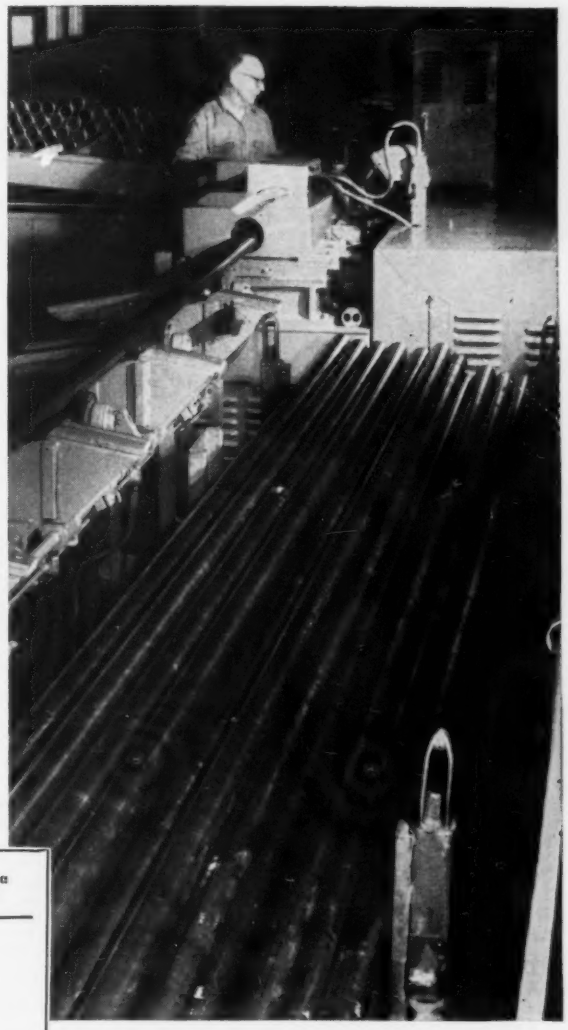
...Fortier, Louisiana

ELECTRUNITE is carefully checked for chemical analysis, physical properties, exact wall thickness, uniformity, to meet critical performance specifications.

ELECTRUNITE Boiler Tubing is hydrostatically or electronically tested to conform with applicable ASTM specifications, the ASME Boiler and Pressure Vessel Code, as well as local, state, and boiler insurance requirements.

ELECTRUNITE is approved on an equal basis with tubes made by other processes up to 850°F. It is available for pressures over 2,000 psi, in various sizes and wall thicknesses.

Solve your boiler, condenser, heat exchanger tubing problems with ELECTRUNITE. Call your Republic representative, or write direct.



Wall Thickness	Minor Dimension of the Defect (Length or Depth)	Length X Depth Area in Square Inches
20 ga.	.006"	.0025"
18 ga.	.006"	.003"
16 ga.	12½% of Wall	.003"
14 and 13 ga.	12½% of Wall	.004"
12 ga. and heavier	12½% of Wall	.005"

FARROWTEST detects and rejects defects completely penetrating tube wall, or equal to, or greater than, those shown in this table. Where required, sensitivity of FARROWTEST equipment can be calibrated to reject defects of lesser specified area than shown in table, at extra cost.

QUALITY YOU CAN MEASURE—FARROWTEST®! Not a laboratory theory, not a mere inspection tool, but an exclusive production test that detects and rejects defects of critical size. FARROWTEST is offered as an alternative to other less positive tests in accordance with table at left . . . at no extra cost.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-6209
221 EAST 131ST STREET • CLEVELAND 8, OHIO

Please send the following literature and information:

☐ Booklet—ELECTRUNITE Boiler Tubes
Booklet—ELECTRUNITE Heat Exchanger Tubing
☐ Carbon Steel ☐ Stainless Steel
☐ Wall Chart—Care and Maintenance of Boiler Tubes
☐ FARROWTEST information

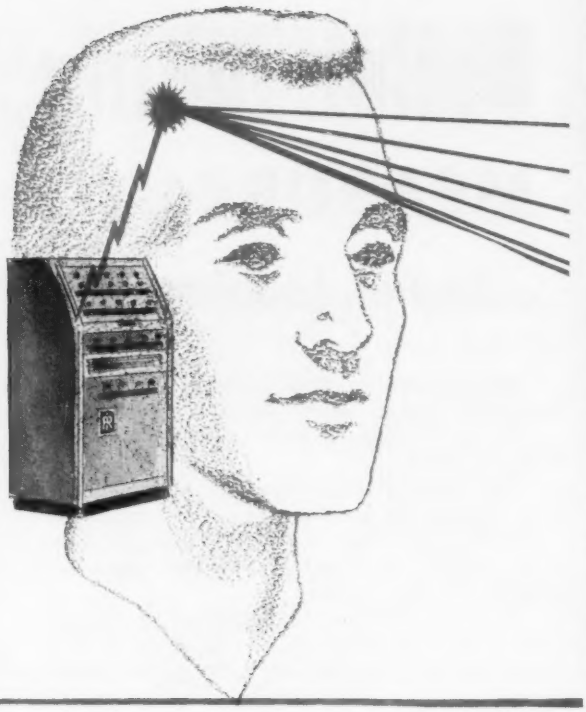
Name _____ Title _____

Company _____

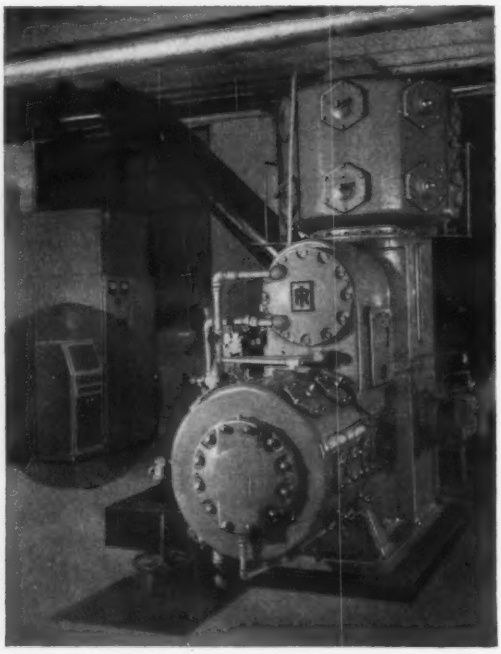
Address _____

City _____ Zone _____ State _____

MACHINES
THAT
MAKE
ENGINEERING
DREAMS
COME
TRUE

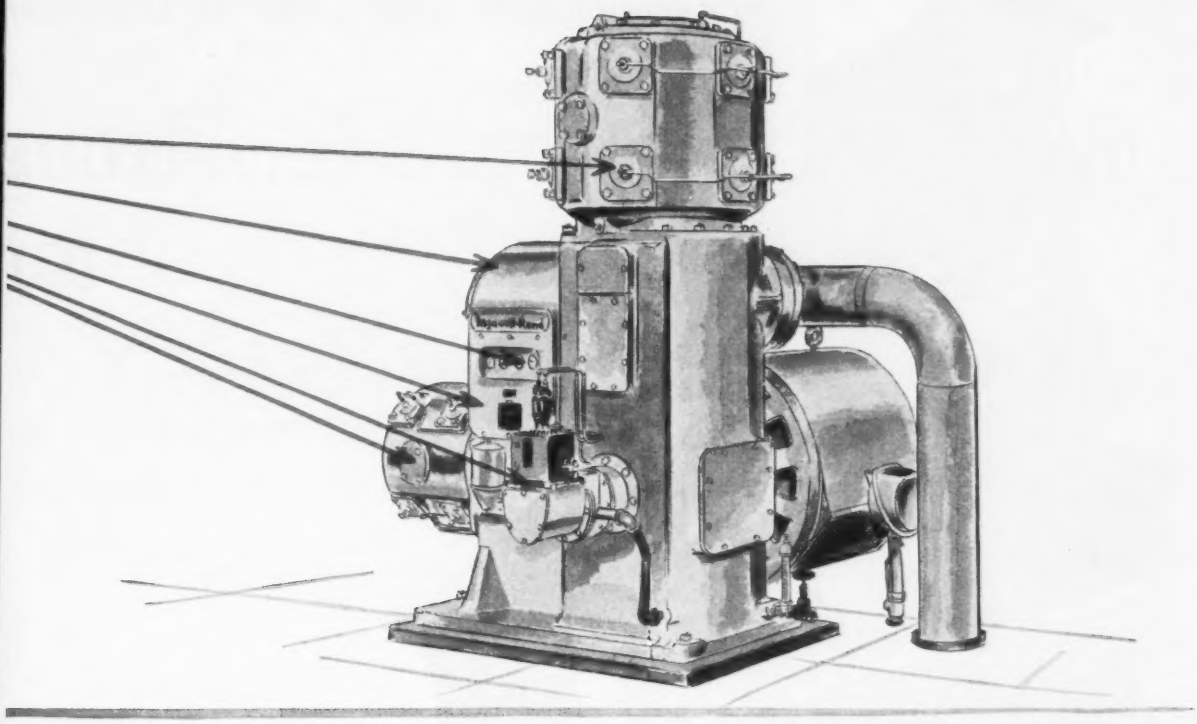


Making a



New 'Tendamatic control brings automatic supervision to the COMPRESSOR PLANT

(left) 'Tendamatic control of this two-stage heavy-duty air compressor, an Ingersoll-Rand type XLE packaged unit with built-in motor, assures maximum protection of capital investment, maximum manpower utilization, continuity of production and lower maintenance expense.



Compressor "Think for Itself"

Ingersoll-Rand's new *'Tendamatic* control is like a tireless attendant who keeps inspecting and checking the operation of the compressor every second.

All you need to do is push the "start" button on the control console. The *'Tendamatic* does everything from then on. You walk away knowing that the compressor is in good "hands". And here's why:

This completely automatic control system anticipates operating difficulties before they develop. It keeps an eye on air pressure and temperatures... lubricating-oil pressure and temperature... the cylinder lubricator... checks the float level in the condensate trap. It checks for leaking valves and mechanical failure of running parts.

Anytime there is a variation from normal compressor operation, the *'Tendamatic* identifies the nature of the malfunction and gives you audible and visible warnings in time to take corrective measures. If the warning is ignored or forgotten, *'Tendamatic* shuts down the compressor before any damage results. If oil pressure fails or if any vibration occurs, it stops the machine *at once* without advance warning.

These built-in safeguards entirely eliminate routine inspection and supervision... detect trouble before it can do any harm to the compressor... put all maintenance on a low-cost *preventive* basis.

For almost 90 years, Ingersoll-Rand has been making engineering dreams come true—with the constant improvement of I-R equipment to meet or anticipate the changing needs of America's growing industries. When you need equipment for compressing air or other gases, moving liquids, condensing steam, drilling rock, creating vacuums, or for industrial cooling, *think first of Ingersoll-Rand.*

'Tendamatic control is available only on Ingersoll-Rand air and gas compressors

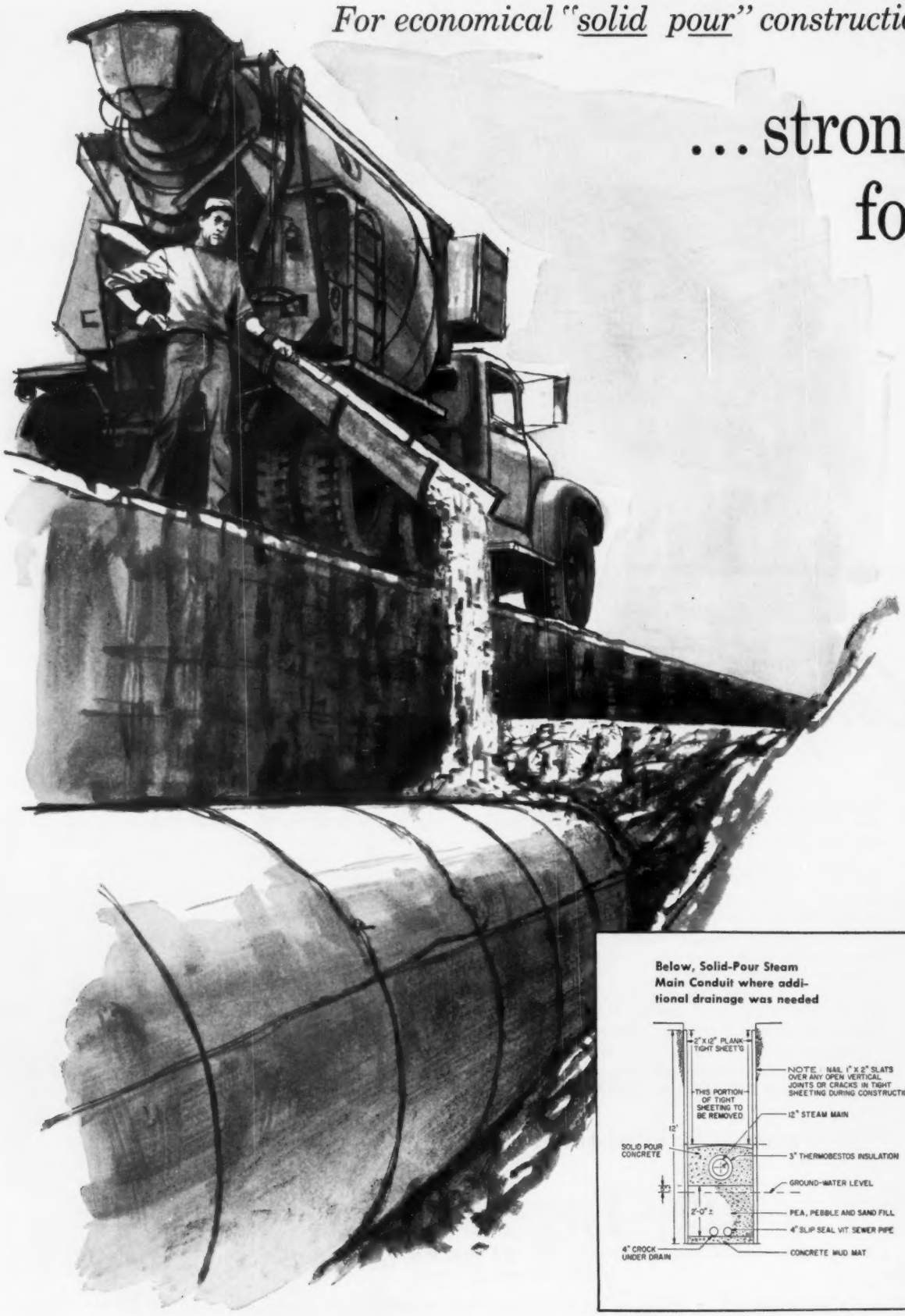
Ingersoll-Rand

1-817 **11 Broadway, New York 4, N. Y.**

GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

For economical "solid pour" construction

... strong
for



Below, Solid-Pour Steam Main Conduit where additional drainage was needed

2" X 12" PLANK TIGHT SHEET'G
NOTE: NAIL 1" X 2" SLATS OVER ANY OPEN VERTICAL JOINTS OR CRACKS IN TIGHT SHEETING DURING CONSTRUCTION
THIS PORTION OF TIGHT SHEETING TO BE REMOVED
12" STEAM MAIN
12"
SOLID POUR CONCRETE
3" THERMOBESTOS INSULATION
GROUND-WATER LEVEL
2'-0" ±
PEA, PEBBLE AND SAND FILL
4" SLIP SEAL VIT SEWER PIPE
4" CROCK UNDER DRAIN
CONCRETE MUD MAT

leading Midwest public utility uses

durable Thermobestos Insulation underground steam lines

Johns-Manville Thermobestos provides its own support in wet concrete . . . after drying, retains its original conductivity—lowest of all the calcium silicates

A GIANT public utility in the Midwest has discovered an ingenious way to use Thermobestos® underground —it's known as the "solid pour" method, and it's illustrated below.

Those who've tried "solid pour" construction will tell you that you can't match its economy—and material savings are truly substantial! There's no pouring of separate bottom, no building and placing of forms, no envelope! And Johns-Manville Thermobestos pipe insulation lets you use this economical method just about anywhere.

Thanks to its high compressive strength, Thermobestos needs no pipe supports, provides its own "no-cost" buffer between pipe and concrete. Thermobestos and "solid pour" methods have been successfully used in areas where drainage problems exist and flooding is a possibility. For even though it should become saturated with water, Thermobestos regains its original low conductivity as soon as it dries out.

Ever since its introduction, Thermobestos has been widely acclaimed throughout the power-generation and process industries for insulating indoor and outdoor pipelines to 1200F. Its *k* factor is the lowest of all insulations in general use for these services.

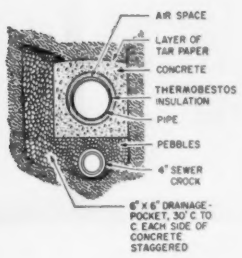
Thermobestos also offers top strength and rigidity; withstands crushing, easily resists unusual service abuse. Yet with all its strength, it is lightweight for easy handling and fast application.

A hydrous calcium silicate that's molded to size for proper fit, Thermobestos is quick, easy to apply . . . its strength makes it particularly adaptable to time-saving prefabrication of fittings and bends. Furnished in large sections, Thermobestos reduces the number of joints needed . . . comes in a complete selection of pipe insulation sizes up to 30″ O.D. Also available in 6″ x 36″ and 12″ x 36″ blocks in a full range of thicknesses.

Let us send you a copy of the informative Thermobestos booklet, IN169A. Write Johns-Manville, Box 14, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE

JOHNS-MANVILLE JM PRODUCTS



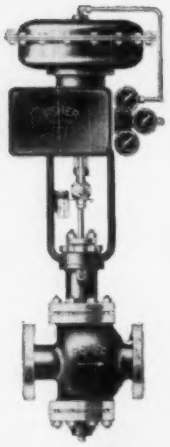
Above, Solid-Pour Steam Main Conduit

Ready for "solid pour." Thermobestos insulation is shown in position with waterproof jacketing partly installed (see diagram for trenching detail).

Easily withstands weight of poured concrete. Here in the same trench Thermobestos is shown with concrete poured solidly around it.

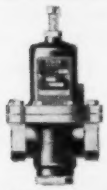
The FISHER

Stocked and Staffed to

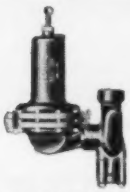


Type 657-A with 3500 Positioner

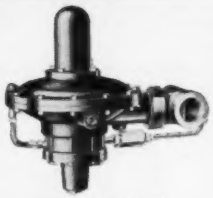
Type 4150 and 4160 Wizard II Pressure Controllers



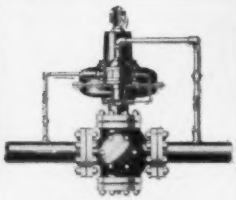
Type 95-H Pressure Reducing Valve



Type 630 "Big Joe" Field Regulator



Series 99-I Multi-Purpose Gas Regulators



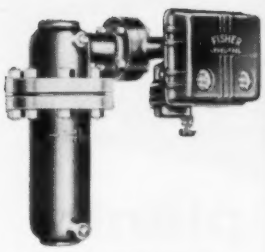
Series 298T Gas Regulators

Type 655-A Pressure Regulator

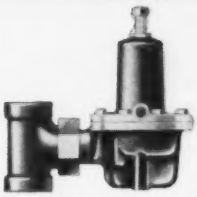
IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

"Supermarket"

give 36 hour Factory service!



Series 2500-249 and
2500-259B
Level-trols
Cage Sizes 14" and 32"



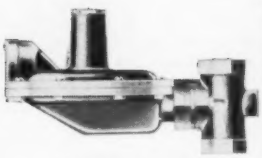
Series 620 and 621
Farm Tap Regulators

Series 67FR Combination Filter Regulator

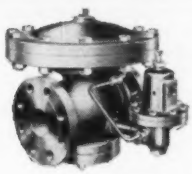
Yes, now you can shop by phone, wire or TWX (Marshalltown 578 or 579) and expect shipment of the equipment illustrated at left in a matter of hours. Now that Fisher Control Valves and Regulators are as readily available as your supermarket groceries, you can meet your emergency needs quickly. Fisher carries a stock of the popular and standard size control valves, displacement type liquid level controllers, pressure regulators and gas regulators on the "supermarket" shelf at all times. The offices in red maintain a wide selection of Fisher equipment in their own inventory.

New items will be added from time to time as needed. Each Fisher representative receives a weekly list of all available types and sizes.

Now, for emergency needs contact either the Fisher representative or the Fisher home office. Your order will be en route within 36 hours (except Saturday and Sunday) after it is received in Marshalltown.



Series S100 and 730
Service Regulators



Type 92B Pilot
Operated Steam
Reducing Valve

AMARILLO
Vinson Supply Company
ATLANTA
J. M. Smither & Company
BALTIMORE
The Rhodes Controls Company
BIRMINGHAM
Joseph W. Eshelman & Company
BOSTON
Clarence B. Petty & Company
BUFFALO
W. J. Sommers Company
CALGARY-EDMONTON
Barber Engineering & Supply Company
CARACAS, VENEZUELA
Sinclair Spence
CHARLOTTE
Robert E. Mason & Company
CHICAGO
General Meters & Controls Company
CINCINNATI
H. T. Porter Company
CLEVELAND
A. E. Ehrke & Company
DALLAS
Vinson Supply Company
DENVER
Joy & Cox, Inc.
DETROIT
DuBois-Webb Company
HOUSTON-CORPUS CHRISTI
Puffer-Sweiven Company
INDIANAPOLIS
Acme Engineering Agency
KANSAS CITY
Sullivan-Mears Company
LOS ANGELES
B. R. Jones & Company
LOUISVILLE
Allan K. Cook Company
MARSHALLTOWN
R. S. Stover Company
MEMPHIS
Johnson & Scott
MEXICO, D. F.
Babcock & Wilcox de Mexico
MILWAUKEE
W. D. Ehrke & Company
MINNEAPOLIS
R. G. Read & Company
MONTREAL
Process & Steam Specialties, Inc.
NEW ORLEANS-LAFAYETTE
John H. Carter Company
NEW YORK
Crabbe & Stebbins Company
ODESSA-FARMINGTON
Vinson Supply Company
PHILADELPHIA
Clifford B. Ives & Company
PHOENIX
Cone & Wallace Company
PITTSBURGH
J. G. Chilcoat & Company
PORTLAND
R. H. Brown & Company
RICHMOND
W. H. Kidd Company
ST. LOUIS
H. D. Hale & Company
SALT LAKE CITY
Williams, Gritton & Wilde
SAN FRANCISCO
George R. Friederich & Company
SEATTLE
Power & Controls, Inc.
TORONTO
George W. Beecroft & Company
TULSA
Vinson Supply Company
VANCOUVER
Northern Columbia Process Equipment Company
WICHITA-LIBERAL
Sullivan-Mears Company
WINNIPEG
Mechanical Valve & Engineering Spec.

Offices listed in red maintain field stock.

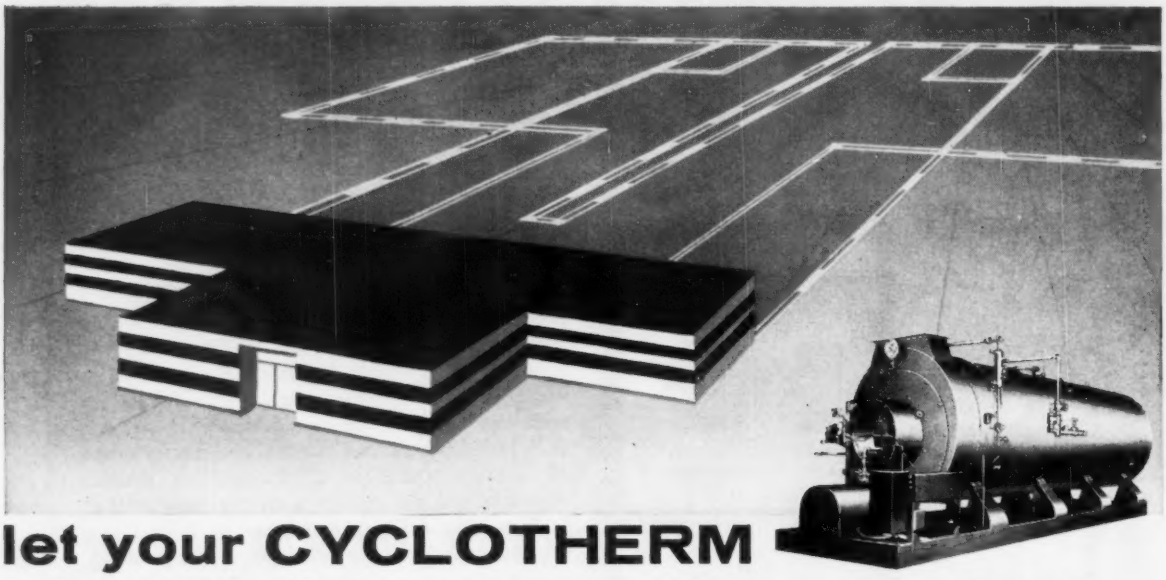
FISHER® Controls

SINCE 1880

FISHER GOVERNOR COMPANY

Marshalltown, Iowa/Woodstock, Ontario/London, England

For a five year plan or a fifty...



let your CYCLOTHERM installation grow with your plant

How much steam will you need five years from now? Or ten? It's easy to blueprint your steam generating future with Cyclotherm Steam Generators. Cyclotherm permits you to add boiler horsepower as you need it. Units from 18 to 750 HP, in 18 sizes. You can add Cyclotherms to your steam capacity like a child adding blocks to a house.

The Cyclotherm is particularly well adapted to multiple installations. It's compact—takes up to one-third less space than other package boilers. It needs no excavation, no foundation. A simple flue takes the place of a towering stack. Completely assembled before shipment, the Cyclotherm is a working unit the minute it reaches your plant. And one manufacturing responsibility stands behind the entire equipment—boiler, burner, instrumentation and all.

Cyclotherm's Cyclonic Combustion guarantees a minimum of 80% efficiency in only two passes. Larger units operate at from 30% to 100% of rated capacity without losses of efficiency—smaller units operate on or off automatically as load requires. Maintenance costs cut as much as 50%. And the world-wide Cyclotherm service organization is always at your disposal. We'd like to plan your steam-generating future with you. Remember too that Cyclotherm is the only manufacturer who has specially designed a complete line of hot water boilers, output per hour from 670,000 to 6,700,000 BTU. Fill out the coupon and a Cyclotherm sales engineer will call.

At J. D. Jewell . . .
One Cyclotherm in 1949;
Five Cyclotherms Today

One of America's largest chicken processors is J. D. Jewell, Inc. (Jewell Whole Cut Up Chicken, Jewell Chicken Pie, etc.) of Gainesville, Ga. And here's how Jewell's growth has been matched by Cyclotherm installations:

1949	100 HP Cyclotherm
1954	150 HP Cyclotherm
1955	18 HP Cyclotherm
1956	80 HP Cyclotherm
1957	150 HP Cyclotherm

And when Jewell processes more chickens, it wil have more Cyclotherms to help process them!

YEARS AHEAD IN STEAM GENERATION
CYCLOTHERM®
STEAM AND HOT WATER GENERATORS

A Division of National-U.S. Radiator Corp., Oswego, N.Y.

Clip to Your Letterhead

Cyclotherm Division
National-U.S. Radiator Corp.
77 E. First St., Oswego, N. Y.

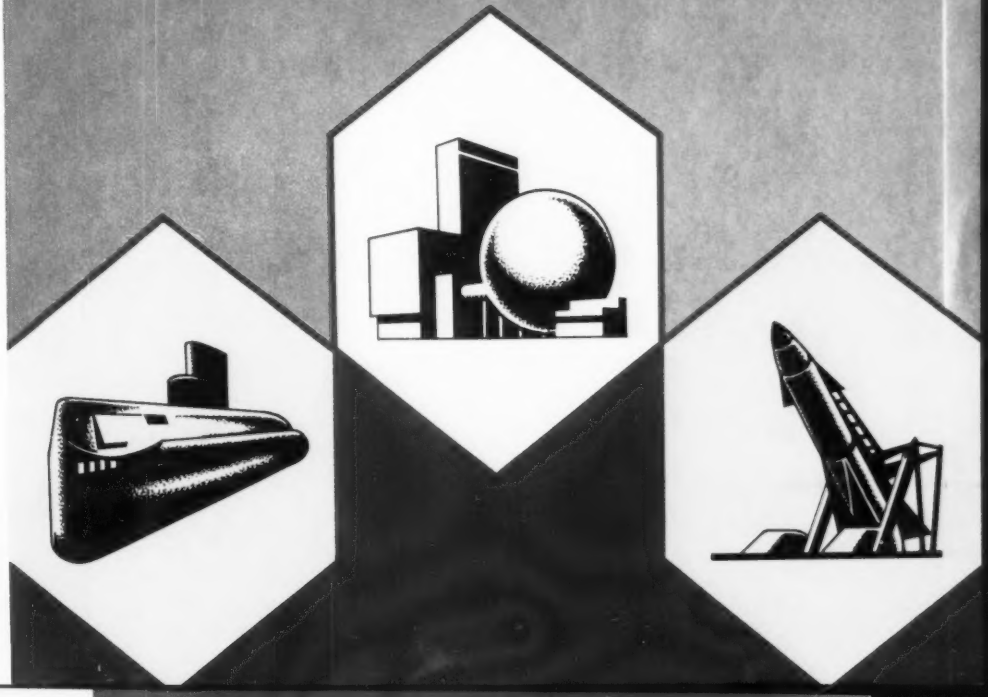
Please send me your booklet *Cyclotherm Cyclonic Combustion*, also rotogravure copy of *Cyclotherm Sales Steam* with illustrations and descriptions of Cyclotherm installations.

Modern Power...Processing... Military Might

CALL FOR

TAYLOR FORGE

FITTINGS • FLANGES • FORGED PARTS



STAINLESS and STAINLESS CLAD STEELS . . . ALLOY or CARBON STEEL . . . TITANIUM . . . . .

A Special seamless 11″ OD x 2.937″ min. wall chrome moly vanadium alloy 180° Return for turbine piping use in supercritical (3500 psi at 1100F) power plant service.

B Manganese moly alloy Inlet Nozzle for nuclear reactor head on aircraft carrier (A2W) propulsion plant. This nozzle, which is 25¼″ long, is bored throughout to an ID of 13¾″. Outside diameters are 21¼″ and 18¾″.

C Stainless clad 16″ OD x 1.093″ wall 53° WeldELL with a 1″ tangent on one end. The stainless lining is ¼″ thick. Designed for aircraft carrier (A2W) nuclear propulsion plant piping, these fittings are made by a unique process developed entirely by Taylor Forge.

D Electric Fusion Welded Stainless Steel Pipe in sizes through 22″ OD, made to extremely stringent specifications, and furnished in 20′ lengths for primary coolant piping in the Commonwealth Edison Company's Dresden, Illinois, nuclear power steam generating plant.

E This 10″ x 8″ x 8″ Schedule 160 Stainless Steel Wye is typical of special designs produced by Taylor Forge over the years for high pressure-temperature oil refinery service.

F There are almost no limitations as to size and wall thickness ratios in which WeldELLS can be produced. This 18″ OD x 3.90″ wall chrome moly fitting is designed for fossil fuel power plant service.

G Stainless Steel Welding Laterals of several sizes are used in reactor coolant piping in S5W atomic submarine propulsion plants. This is 14″ x 10″ x 10″ size, with lateral at 50° 30′ angle. Design conditions are 2500 psi at 650F.

Also supplied for use in nuclear reactor piping is this special wall thickness 16″ OD Stainless Steel Cap.

H

12″ x 10″ Schedule 160 Stainless Steel Concentric Reducer with square ends. Furnished for classified atomic research facility.

I

Taylor Forge is America's first and largest manufacturer of Forged Flanges. This 8″ 2500 lb. Stainless Steel Welding Neck Flange with special spot facing is typical and flanges of this type are made for any pressure-temperature condition.

J

Special heavy wall Stainless Steel Header Type Fitting. Run is 14″ OD and approximately 60″ long with 12″ outlet.

K

Bull Head Tees, such as the 8″ x 8″ x 12″ Schedule 160 fitting pictured here, can often improve designs in high pressure-temperature oil refinery and power plant piping.

L

Contoured Outlet Headers are made by Taylor Forge in any required size, thickness and outlet arrangement. Widely used for Valve Settings, Gas Compressor Manifolds, Central Power Station Headers, etc., they also find many applications in the process industries.

M

NICKEL . . . MONEL . . . INCONEL . . . HASTELLOY . . . EVERDUR . . . ALUMINUM . . . MAGNESIUM . .

TRADITIONALLY DEPENDABLE

For Nuclear OR FOSSIL FUEL Power Plant Service

Wherever piping requirements are extremely exacting, where even minute surface flaws cannot be tolerated and interior structure must be perfect—in other words, where the very highest *quality standards* must be maintained, TAYLOR FORGE can be relied upon as a completely dependable source for Welding Fittings, Forged Flanges and Nozzles, Forged Headers and other piping system and pressure vessel components.

The unusual designs and extremely stringent specifications encountered in nuclear power reactor piping provide an excellent example of such exacting requirements. And Taylor Forge has the distinction of having supplied essential parts for important nuclear installations, including nuclear powered steam generating plants and ship propulsion units, ever since the very birth of the "Atom Industry". In addition, Taylor Forge products are installed in every major facility for the production of fissionable materials.

This is quite understandable, of course, because for more than 50 years, Taylor Forge has been a recognized leader in the design and development of power piping and pressure vessel components.

. . . and for Process Piping

In this field, too, particularly in Petroleum Refining and Petro-Chemical plant operations, severe service conditions often impose most rigorous requirements, so restrictive as to call for greatest care in the selection of designs and materials.

And here, too, experienced engineers and designers have learned to "turn to TAYLOR FORGE" for piping and pressure vessel parts of unquestioned quality. Such products are available from Taylor Forge not only in carbon, alloy and stainless steels, but also in any other forgeable material that may be required.

. . . for Missile, Aircraft and Machinery Parts

Known everywhere as an outstanding producer of precision forged, rolled and extruded parts for missiles, jet engines and heavy machinery applications, Taylor Forge's eminence is even more emphatically recognized when these parts are required of special materials such as stainless, titanium, the newer so-called "exotic materials," and other metals generally classed as "hard-to-work".

The tremendously large and varied assortment of presses, hammers, ring rolling mills, special machines and related production equipment operated in the five U. S. plants of Taylor Forge (plus one in Canada) . . . the complete laboratory facilities for chemical, physical and metallurgical testing and control . . . the accumulation of superlative technical and engineering skills acquired during more than half a century of experience in this field . . . all these reasons justify the selection of Taylor Forge as the preferred supplier of such products.

M . . . and all other forgeable metals

N Titanium Hemisphere for missile fuel bottle. This closed die hammer forging is 26″ ID with ¾″ thick wall. Also produced in other sizes and metals.

O Extruded jet engine component. This part is approximately 60″ long with 24″ diameter head and 4½″ diameter shaft.

P Stainless Steel Turbine Shaft for jet engine. Both press forging and extruding operations are employed in forming this part.

Q This 42″ OD x 16″ long Stainless Steel Turbine Case is representative of products formed by Taylor Forge ring rolling methods. Seamless rings are made in sizes to 120″ OD with practically any required section.

R Heat Sink for long range missile. This press forged Stainless Steel part is 64¾″ OD and 1½″ in wall thickness.

Welding Fittings . . . Forged Flanges . . .
Forged Headers . . . Welding Necks . . .
Missile and Aircraft Forgings . . .
Seamless Rolled Rings . . .
Electric Fusion Welded Pipe . . .
Spiral-Weld Pipe

T F

TAYLOR FORGE

The Complete Line

Welding Fittings,

Forged Flanges,

Large Diameter Rolled Flanges,

Welding Necks and related products

Includes every size, type, thickness, pressure rating and material covered by Standards, Tentative Standards, Standard Practices or Recommendations as issued by such regulatory bodies as:

Amn. Standards Assn. (ASA)
Amn. Soc. for Testing Mtls. (ASTM)
Amn. Soc. of Mech. Engineers (ASME)
Amn. Water Works Assn. (AWWA)
Tubular Exchanger Mfrs. Assn. (TEMA)
Mfrs. Standardization Soc. (MSS)
Amn. Gas Association (AGA)
Military and other governmental departments

In addition, Taylor Forge manufactures a number of piping and pressure vessel parts of types not covered by, and in sizes extending beyond the range of any Standard.

Taylor Forge & Pipe Works

General Offices and Works:
P.O. Box 485, Chicago 90, Ill.

Plants at: Carnegie, Pa., Gary, Ind., Houston, Texas, Fontana, Calif., Hamilton, Ont., Canada

District Sales Offices:
New York, Boston, Philadelphia, Pittsburgh, Atlanta, Chicago, Houston, Tulsa, Los Angeles, San Francisco, Seattle, Toronto, Calgary, Montreal.

"... no one could go wrong in buying a Nordberg engine ..."

says Mr. Walter Scales
Manager
Conway Corporation
Conway, Arkansas

The Conway Light, Power and Water System is owned by the City of Conway, Arkansas, and operated by the Conway Corporation. Mr. Walter Scales, its manager, has this to say about Nordberg power:

"*Our first Nordberg engine was installed late in 1951. That engine now has over 36,000 hours of running time on it. During the calendar years 1952 thru 1956 the engine was on the line 75% of the possible running time. During one period of 43 consecutive months the engine was operated over 90% of the possible running time and accounted for 75% of our total plant generation during that period.*

"*Our second Nordberg went into operation in 1956 and now has over 8,000 hours on it. There is every indication that it will be as satisfactory, and even more economical, than the first engine. Our opinion is that no one could go wrong in buying a Nordberg engine.*"

When you need *long-term, dependable* power, consult Nordberg . . . builders of a full line of engine sizes from 600 to over 12,000 hp, including Diesel, Duafuel® and Spark-Ignition Gas types.
NORDBERG MFG. CO., Milwaukee, Wisconsin

Installation Data:

City of Conway, Arkansas:

Two Nordberg 2-cycle Duafuel® engines installed, total of 6225 hp.

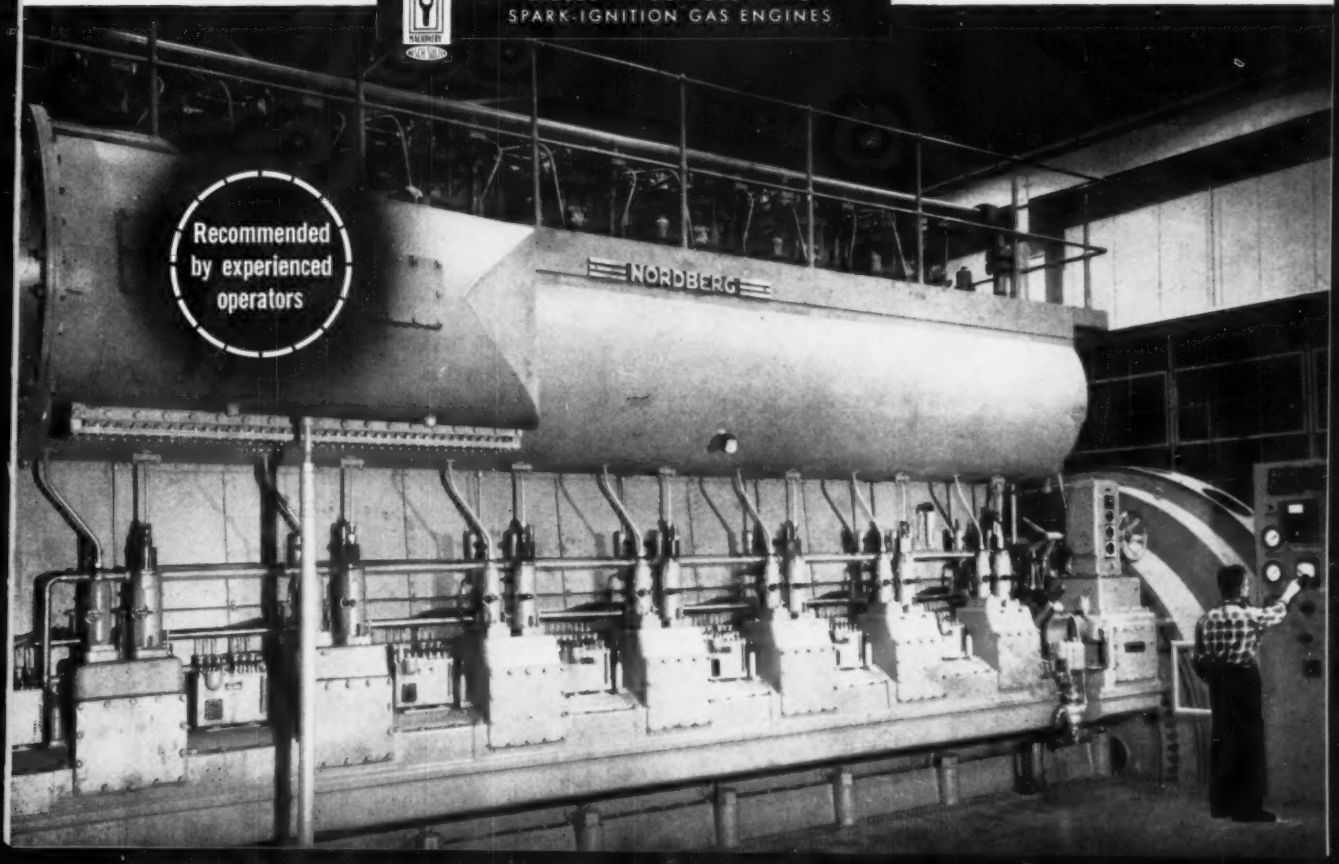
- First engine installed late 1951 . . . rated 2750 hp, 1940 kw.
- Second engine installed late 1955 . . . rated 3475 hp, 2470 kw.

NORDBERG

DIESEL • DUAFUEL® AND SPARK-IGNITION GAS ENGINES

© 1957, Nordberg Mfg. Co.

P657



College puts

coal at head of class

Otterbein College saves 42% with coal, installs revolutionary package boiler

Otterbein College, Westerville, Ohio, has discovered truly efficient heat generation. Otterbein's new heating plant burns coal in Coal-Pak boilers—developed by Bituminous Coal Research, Inc.—for automatic performance plus unique simplicity of operation. The result . . . savings in manpower . . . and a spotlessly clean plant.

In addition, comparative fuel cost studies have proved that coal costs 42% less per million Btu than the nearest competitive fuel in this area . . . a bonus savings! And, in keeping with the modern operation of this plant, the entire interior has been brightened by an attractive color scheme.

Facts you should know about coal

You'll find that bituminous coal is not only the lowest-cost fuel in most industrial areas but up-to-date coal burning equipment can give you 15% to 50% more steam per dollar. Today's automatic equipment can pare labor costs and eliminate smoke problems. And vast coal reserves plus mechanized production methods mean a constantly plentiful supply of coal at stable prices.

Technical advisory service

To help you with industrial fuel problems the Bituminous Coal Institute offers a free technical advisory service. We welcome the opportunity to work with you, your consulting engineers and architects. If you are concerned with steam costs, write to the address below. Or send for our case history booklet, complete with data sheets. You'll find it informative.

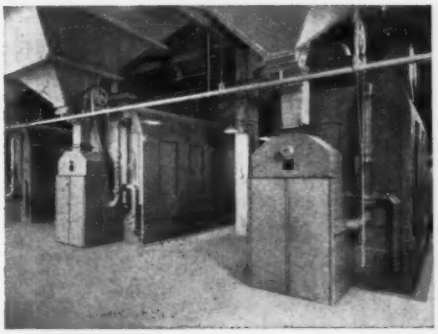
Consult an engineering firm

If you are remodeling or building new heating or power facilities, it will pay you to consult a qualified engineering firm. Such concerns—familiar with the latest in fuel costs and equipment—can effect great savings for you in efficiency and fuel economy over the years.

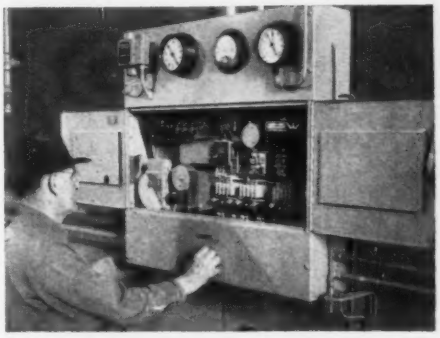
BITUMINOUS COAL INSTITUTE

Department P-8

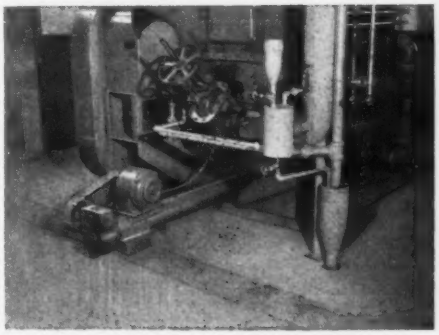
Southern Building • Washington 5, D. C.



Heating plant at Otterbein showing the three Coal-Pak Automatic Water Tube Generators, by International Boiler Works Co. (Licensed under pending patents of Bituminous Coal Research, Inc.) Coal storage hoppers at top of photograph hold 30-35 tons of coal each.

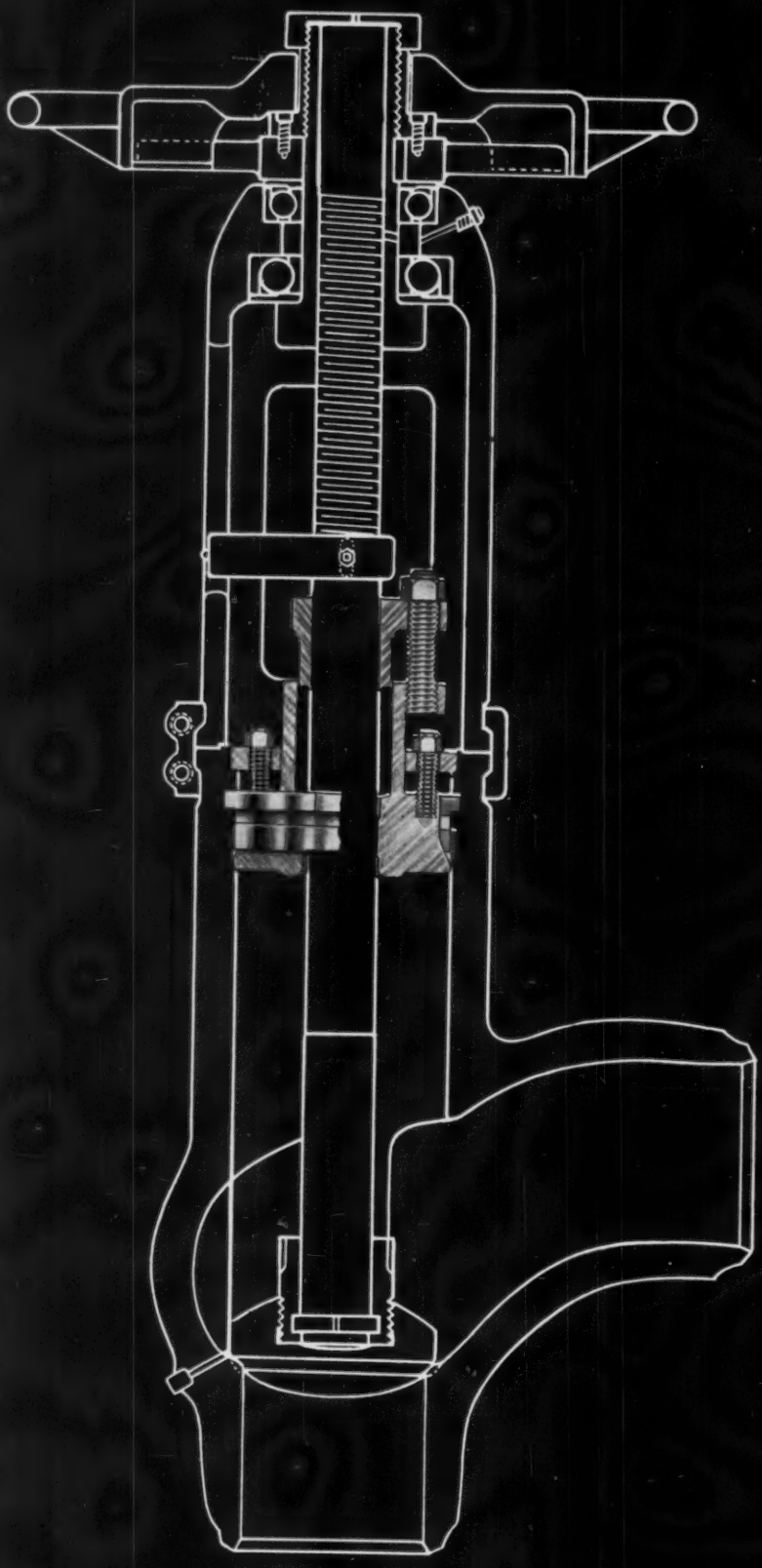


Single switch on front of cabinet enables operator to change from "run" to "hold-fire" operations. Each generator has its own rugged, non-electronic combustion control system, housed in tamper-proof locked cabinet. It controls safely and efficiently the starting-up sequence, coal feed, fuel-air ratio, hold-fire operation and ash removal.



Rear of generator, showing part of dustless ash disposal system. Ash removal is an integrated feature of the package operation—no manual handling. Ashes are removed by screw conveyor. They pass into main screw conveyor recessed into the floor (covered by metal plate) and are carried outside.

Coal is delivered by truck and dumped through any of nine manholes into storage hoppers below. From hoppers, it is gravity fed into stokers. Four-foot wall around coal dumping platform permits use of platform for outside coal storage, holding additional 250 tons.



EDWARD PRESSURE-SEAL ANGLE VALVE

What's New from Edward Valves

New Products . . . Problems and Solutions. . . Information on Steel Valves from Edward, Long-Time Leader in the Field!

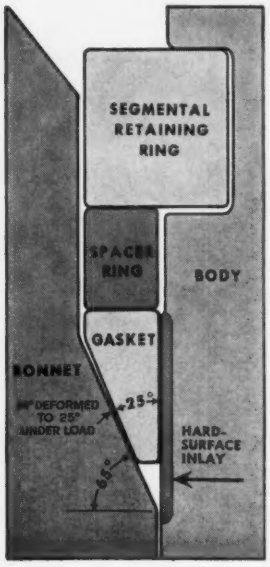
Not A Single Failure Reported In 5 Years

on unique "Pressure-Seal" body-bonnet joint!*

Advances in service temperatures (above 800 F) led to introduction, in 1945, of commercial steel valves with pressure-seal bonnet joint construction. These superseded bolted joint valves of earlier design.

The original 45° pressure-seal gasket, used by Edward and other manufacturers, was a significant improvement in minimizing leakage. But scientists in the Edward Research Laboratories refused to accept this as the best that could be done, set out to develop a better pressure seal joint.

In 1953 Edward research paid off: a completely new Edward pressure-seal design—with 25°–65° joint—was introduced. Design is shown in diagram on this page. The change in gasket angle, plus other Edward improvements described here, brought an end to bonnet joint leakage in pressure-seal valves.



Literally thousands of Edward pressure-seal valves have been installed since 1953 in a great variety of services. Of these, *not a single case of failure has ever been reported.*

Here's Why Edward Improved "Pressure-Seal" Succeeded:

SEALING AREA MULTIPLIED!
Improved gasket design *triples* sealing surface area, virtually eliminates possibility of leakage.

SEALING FORCE DOUBLED!
Angular relationship of bonnet, gasket and body directs more line load *outward* against the gasket, doubles sealing force.

SPECIAL GASKET SEAL-COATING!
A special corrosion-resistant malleable coating (.001 inch thick) is applied to gasket, flows into minute irregularities, assures perfect seal.

IMPROVED BODY SEALING SURFACE!
Possibility of any microscopic casting porosity in vital body-gasket sealing zone is avoided by inlay of corrosion resistant hard-surfacing material.

EASY DISASSEMBLY!
Body bore has been enlarged just above gasket area; this permits gasket to be easily lifted out, after segmental retaining ring and spacer are removed.

GASKET DAMAGE ELIMINATED!
Sharp edge of gasket has been rounded-off, eliminates possible damage to gasket during handling or storage.

EDWARD VALVES, INC.

1230 West 145th Street, East Chicago, Indiana

Subsidiary of

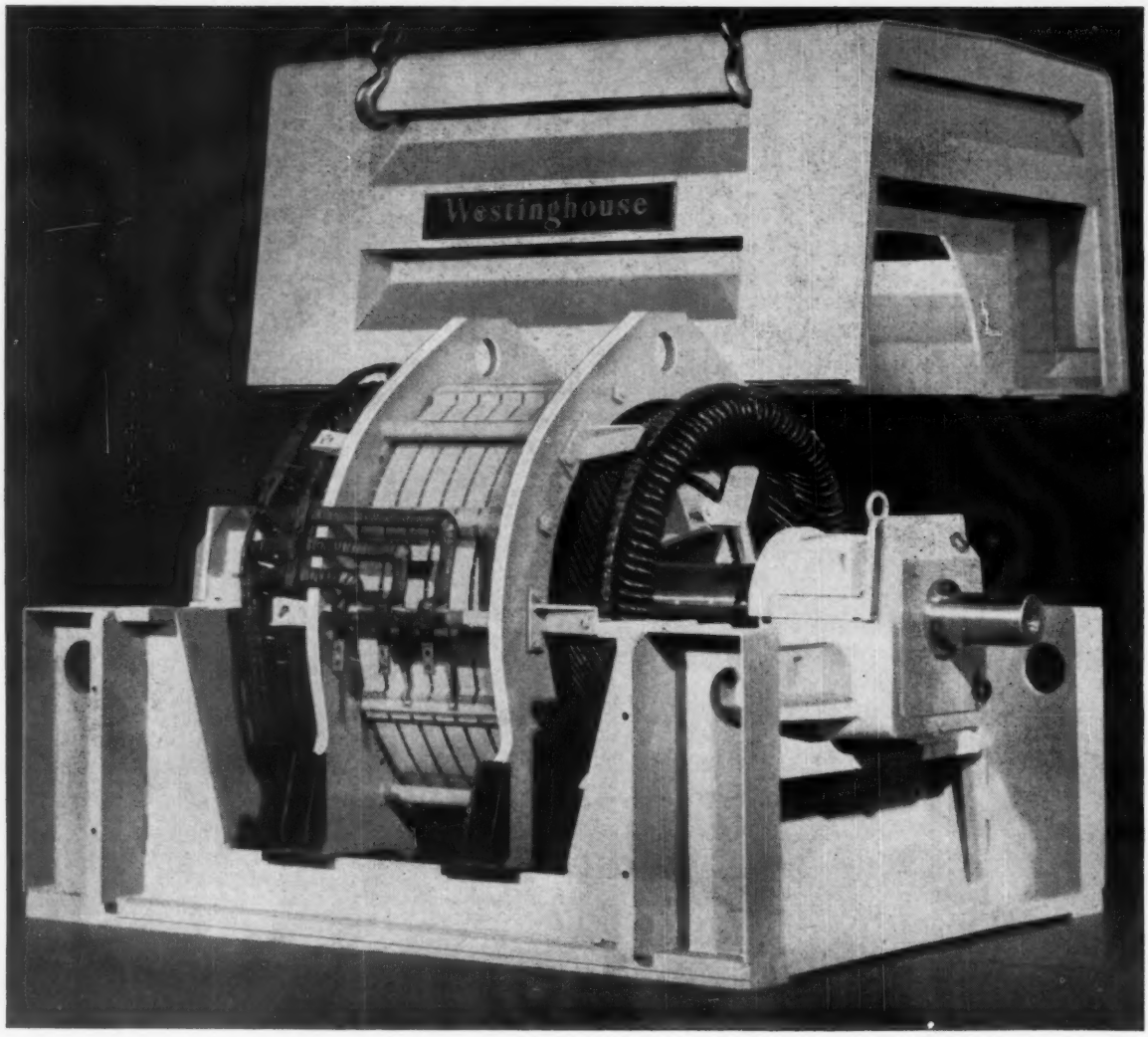
ROCKWELL MANUFACTURING COMPANY

Represented in Canada by
LYTLE ENGINEERING SPECIALTIES, LTD., 360 Notre Dame St. W., Montreal 1, Que.

Edward builds a complete line of forged and cast steel valves from ¼" to 18"; in globe and angle stop, gate, non-return, check, blow-off, stop-check, relief, hydraulic, gage and special designs; for pressures up to 10,000 lbs; with pressure-seal, bolted, union or welded bonnets; with screwed, welding or flanged ends.

*T. M. Reg. U. S. Pat Off.

Revolutionary new Westinghouse F/A Motor gives you five major advantages



First fully accessible motor ... takes guesswork out of inspection

For the first time in large motor history, the motor housing is completely separate from the stator, with all the benefits such construction implies.

Inspection — once a matter of partial visibility and guesswork — is now a thorough and easy operation which insures your motor investment. Advantages impossible in conventional motors are standard features of this F/A Motor design.

1. Full accessibility. Total inspection is possible for the first time. Enclosures are quickly removed, easily replaced. Reassembly is automatically precise.
2. Inherently quiet. Housing is isolated from the stator, reducing transmission of vibration and noise.
3. Thermalastic® insulation. Recognized as the finest available, it assures long life and protection of coils.
4. The same basic components — rotor, stator, bearings — which have made Westinghouse motors famous for long, efficient service life.
5. Easy to connect. No conduit box. Cables pass through the base bottom with extra-ample room to connect motor leads.

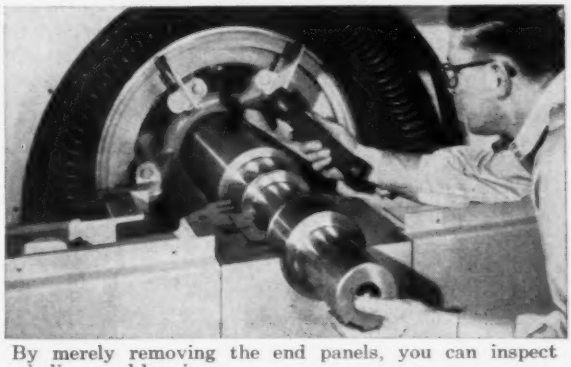
These and many other qualities make the new Westinghouse F/A Motor your best investment. It is presently available in large induction motors, both squirrel-cage and wound rotor. Various types of enclosures include dripproof, splashproof, weather protected, force ventilated, enclosed self-ventilated with cooler and TEFC tube type. Horsepower ratings range from 250 up to 7000, depending on speed.

For full information, call your Westinghouse representative, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna.

J-15011

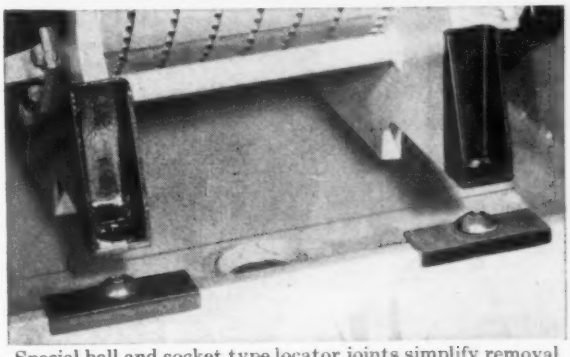
YOU CAN BE SURE...IF IT'S Westinghouse

Protruding conduit boxes are gone. Cable comes up through the base, leaving plenty of room for connecting motor leads.



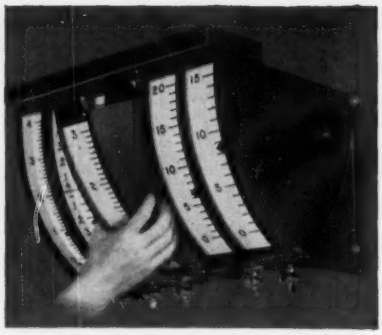
By merely removing the end panels, you can inspect windings and bearings.

Remove bearing cap, top bearing shell and oil ring; then the bottom bearing shell rolls out for easy inspection.

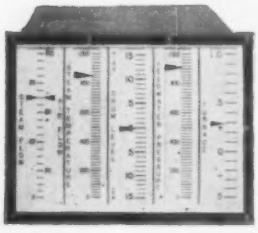


Special ball and socket type locator joints simplify removal and replacement of stator. In reassembly, perfect realignment is automatic.

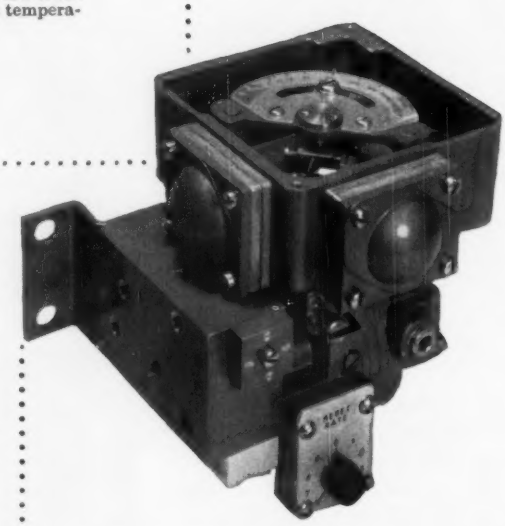
REPUBLIC BOILER METER provides, in one instrument and on one chart, all information essential to efficient boiler performance. Indicates, records and integrates steam flow from boiler and records rate of air flow for combustion. When air is correct for best combustion, air flow record coincides with steam flow record, regardless of boiler load. A third element can be added to record flue gas temperature or steam pressure. Write for Bulletin 420.



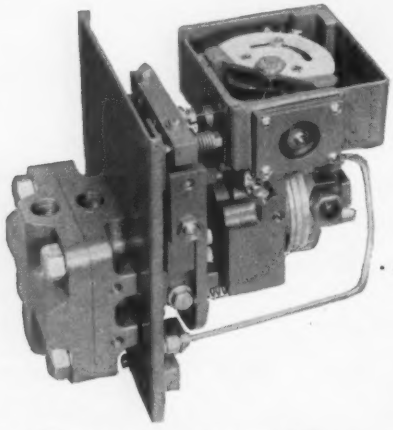
REPUBLIC MULTI-POINT GAUGES have 12-inch scales to measure draft, pressure, differential pressure and temperature. These highly-accurate gauges are sturdy and dependable, easy to maintain and simple to adjust. Suitable for flush or semi-flush mounting. Write for Bulletin 58-12.



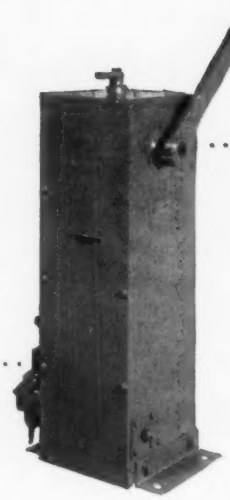
REPUBLIC V5 SERIES GAUGES match the performance of much larger gauges, yet require only one-fourth the panel space. These compact instruments measure draft, pressure, differential gas pressure and temperature. May also be used with pneumatic transmitters to indicate flow, liquid level, temperatures and pressures. Suitable for individual or multiple mounting. 5-inch illuminated scales. Full sized measuring elements. Duplex units available. Write for Bulletin 806.



REPUBLIC TYPE VC PNEUMATIC CONTROLLER is designed for use with transmitters having an output of 3-to-15 psig; its own output is identical. Available with pneumatic or spring loaded set point. Proportional band adjustable from 2% to 500%. Reset adjustable from 0.1 to 50 repeats per minute. Dead band is less than 0.05%. Write for Bulletin 57-2.



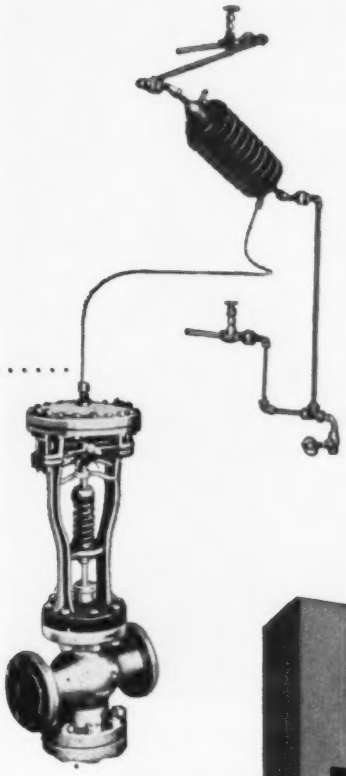
REPUBLIC VDP PNEUMATIC DIFFERENTIAL PRESSURE TRANSMITTER is ideal for steam flow measurement. Has extremely wide range adjustment (20-to-1) without parts change or zero setting adjustment. Accuracy within 1% of top scale value. Special non-bleed pneumatic amplifier has low air consumption (less than 0.2 scfm), high output capacity (1.0 scfm) and high gain. Companion model: low-static, low differential pressure, ideal for measuring combustion air flows. Write for Bulletin 58-11.



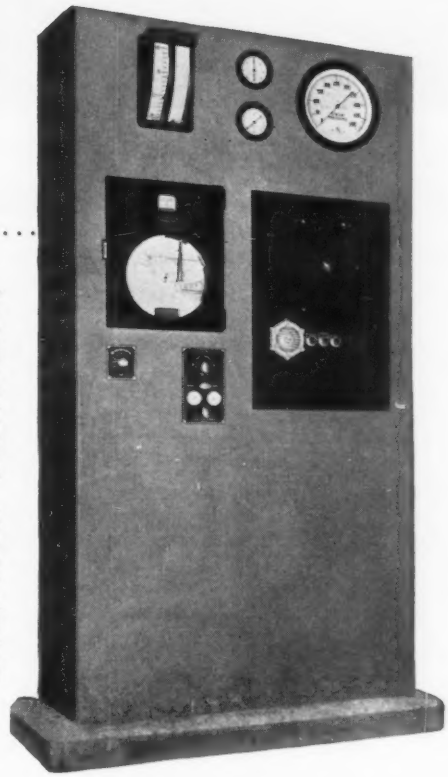
REPUBLIC SERIES 77S FINAL DRIVE UNIT is a powerful final link for positioning valves, dampers, etc. This compact unit can be installed horizontally or vertically, indoors or out. Drive lever mounts on either end of the shaft. Local manual positioning provided for in the event of air failure. Quick response without hunting is inherent in design. Proportionality of signal response can be tailored by cam shaped on the job. Write for Bulletin 56-3A.

CUT STEAM COSTS

with REPUBLIC INSTRUMENTS and CONTROLS



REPUBLIC TYPE FW-1 THERMO-HYDRAULIC FEEDWATER CONTROL SYSTEM. Automatically regulates water level in boilers to 600 psig pressure, and with ½-inch to 4-inch diameter feed lines. Needs no outside source of power. Simple, rugged system consists of pressure generator, regulating valve and connecting tubing. All components accessible for simple maintenance needs. Write for Bulletin 56-2.



REPUBLIC AUTOMATIC COMBUSTION CONTROL SYSTEM PANEL. This one controls a 15,000 lbs/hr gas-fired package boiler supplying 235 psi steam. System features on/off and modulating operation, and flame failure control. Instruments include Republic 2-Unit Draft Indicators and Type EST Boiler Meter with Flue Gas Temperature Pen.

Republic systems automatically maintain constant steam pressure by controlling heat input to boiler in balance with boiler load. They automatically maintain highest combustion efficiency by controlling fuel and air input simultaneously, and automatically maintain any desired load division.

Whether you operate package boilers or a central station, low steam costs depend upon accurate regulation of fuel, air and feedwater in terms of immediate steam demand. Republic has pioneered in cutting those costs since the early 1900's.

From this half-century of experience has come a complete line of carefully engineered components, and complete systems for every phase of steam production, regulation and measurement. Shown here, for example, are just a few of the Republic instruments and controls that can cut steam costs in a package boiler installation.

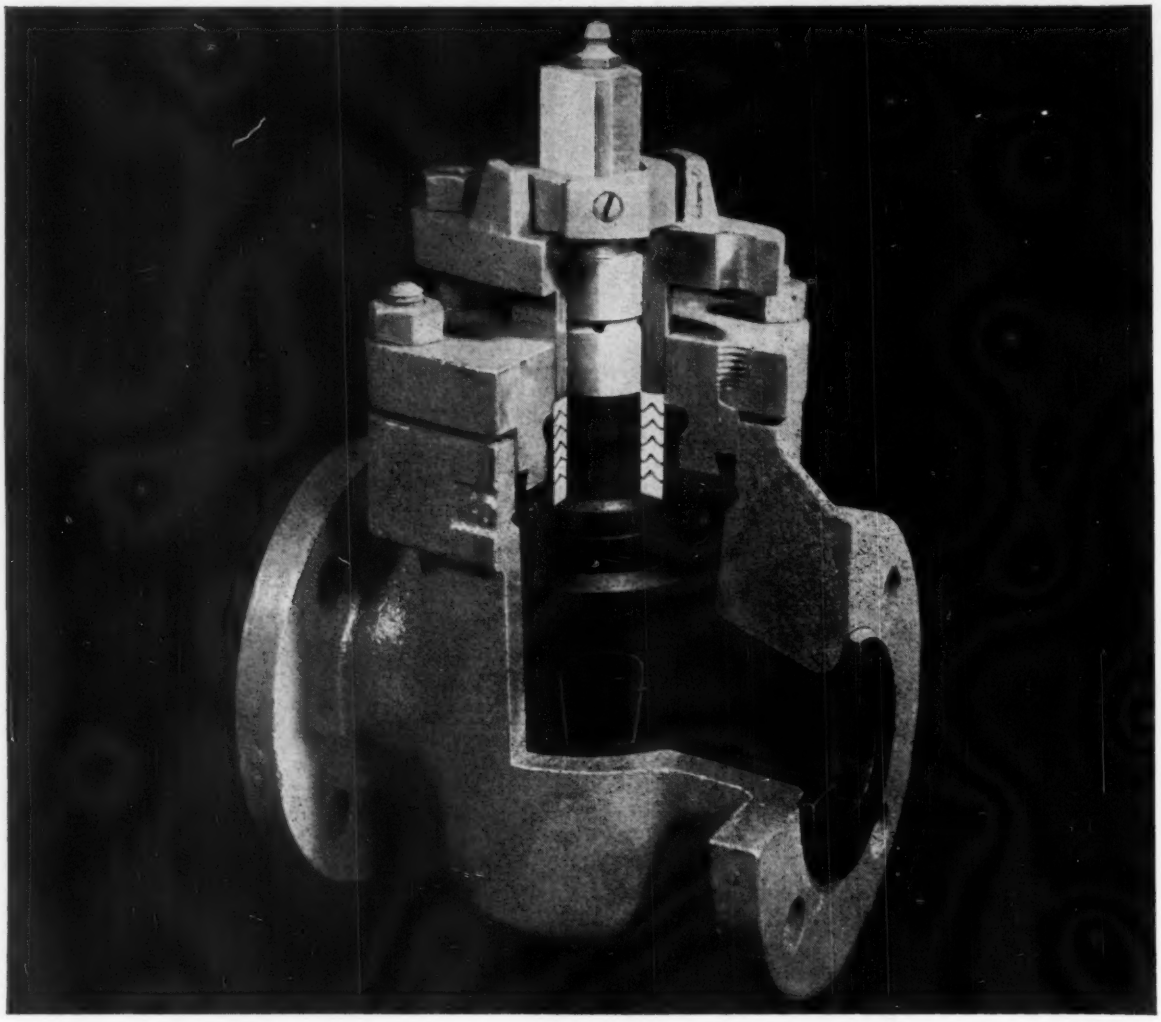
But there's more to it than that. Really efficient steam production demands that these instruments and controls be correctly applied. Republic can help you. We place at your disposal years of practical engineering experience with steam plants of all sizes . . . all pressure and temperature ratings . . . all load characteristics.

To get the facts you want, contact your nearest Republic sales office; they're located in principal cities throughout the United States and Canada. Or, write to...

REPUBLIC
FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY
2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS
In Canada: Republic Flow Meters Canada, Ltd.—Toronto

Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.



Here's why Saran Lined Pipe prevents water contamination

Highly reactive demineralized water will not react with the new gray saran lining

Water contamination in a power system can be costly. Mineral deposits from contaminated water can do thousands of dollars' worth of damage to expensive power generating equipment. That's why economy-minded power engineers are specifying complete saran lined piping systems and Saraloy® 898 tank linings.

Tough, corrosion-resistant saran is an inert material that won't react with demineralized water. Pipe, valves, pumps and fittings lined with the new gray saran permit design of complete piping systems for operations from full vacuum to 300 psi and temperatures from -20° F. up to 200° F. Saran Lined Pipe is safe, having the strength of its steel casing. Its design permits fabrication of joints in the field. Saran Lined Pipe, valves, pumps, fittings and Saraloy 898 tank linings are available for immediate shipment.

Write today for more information on why you should specify a complete piping system lined with saran and Saraloy 898. THE DOW CHEMICAL COMPANY, Midland, Michigan.

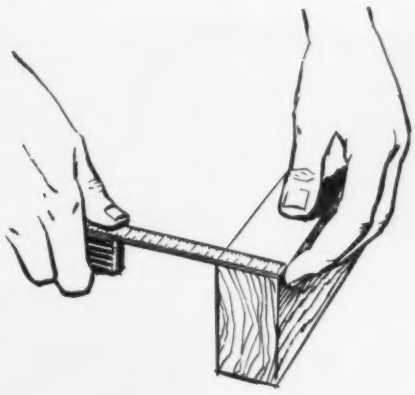
SARAN LINED PIPE COMPANY
DEPT. 20U
2415 BURDETTE AVENUE
FERNDALE 20, MICHIGAN

Please send me information on: ☐ Saran Lined Pipe, fittings and valves ☐ Saran lined centrifugal pumps ☐ Saraloy 898 chemical-resistant sheeting

Name_____ Title_____ Company_____

Address_____ City_____ State_____

YOU CAN DEPEND ON DOW



Measure COOLING TOWER LIFE with a RULER?

YES! **DIMENSION** and **QUALITY** of redwood are the obvious and fundamental cornerstones on which long service life and low maintenance costs must rest. They are your **ONLY** protection against delignification or chemical attack! Coupled with proper wood preserving treatment, they provide the necessary safeguards even in those areas where biological attack is prevalent.

COMPARE WHEN YOU BUY — AND INSIST ON GETTING THESE FOSTER WHEELER STANDARDS

THICKNESS COMPARISON OF IMPORTANT TOWER COMPONENTS

TOWER COMPONENTS	FOSTER WHEELER	MANUFACTURER "A"	MANUFACTURER "B"
SPLASH BARS	1"	1"	3/8"
FILL DECK SUPPORTS	2"	1"	1/2"
WATER DISTRIBUTION SYSTEM	2"	1"	1"
FAN STACK SHEATHING	1 1/2"	1"	3/8"
AIR INLET LOUVERS	1"	1/2"	1/2"
DRIFT ELIMINATOR BLADES	9/16"	7/16"	5/16"

"To conserve water is good business . . . for you, your neighbor, and the Nation."

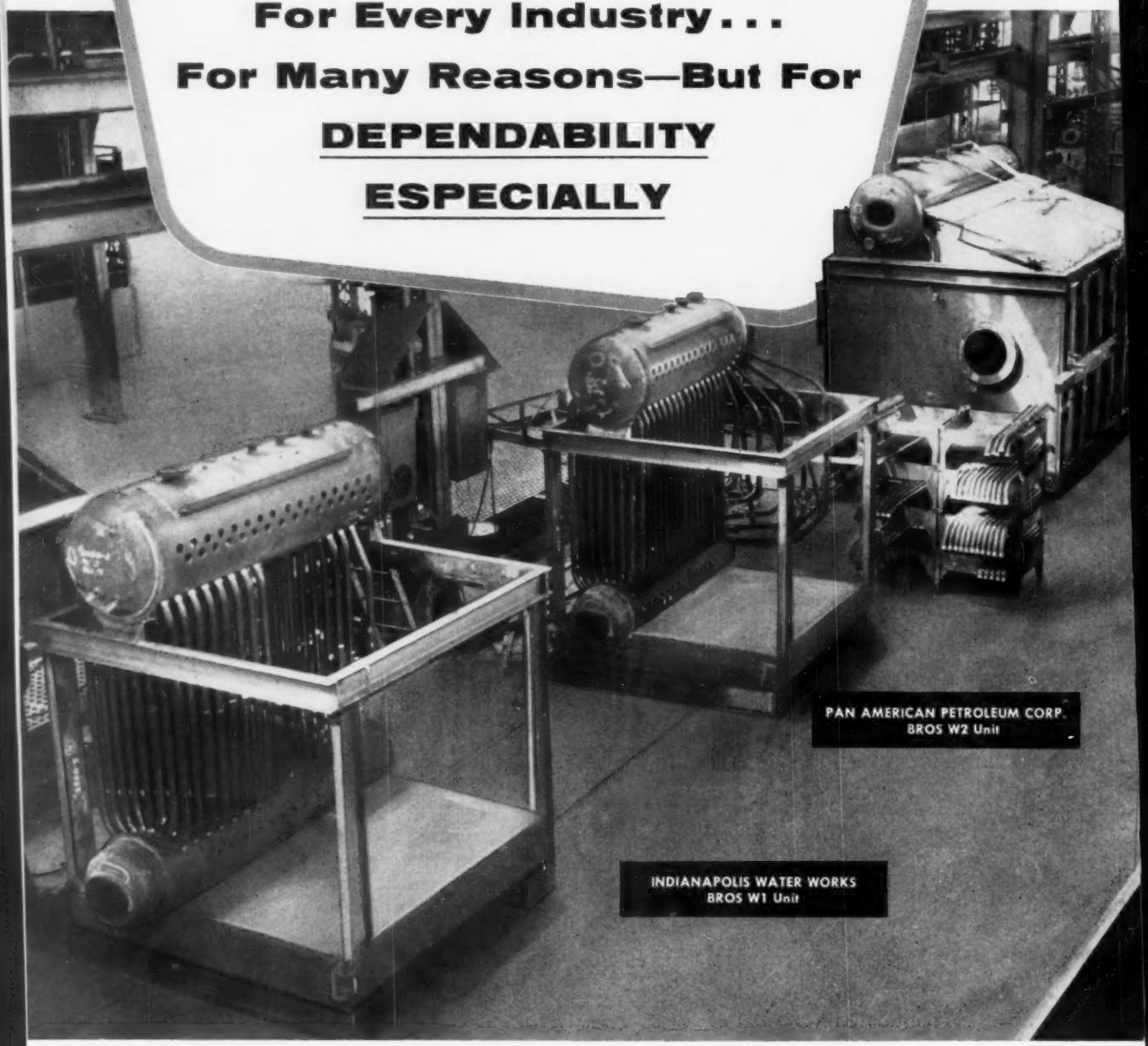
FOUNDER MEMBER CTI COOLING TOWER INSTITUTE

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

BROS

Packaged Boilers For Every Industry... For Many Reasons—But For DEPENDABILITY ESPECIALLY

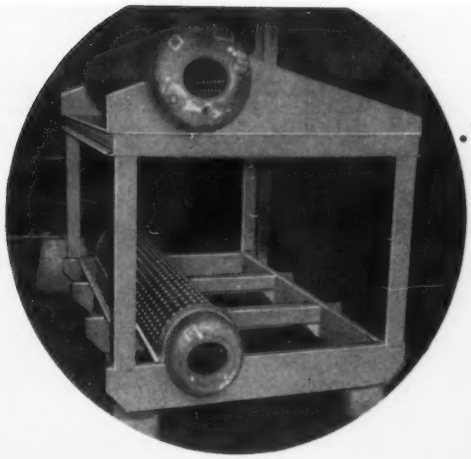


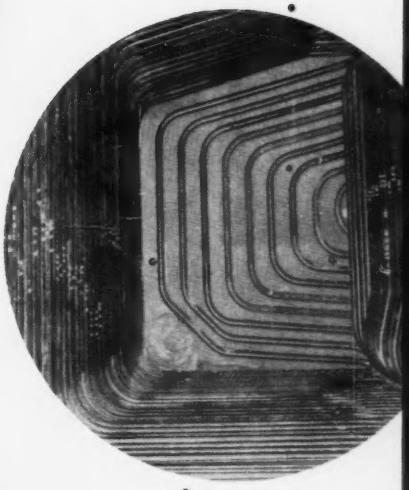
PAN AMERICAN PETROLEUM CORP.
BROS W2 Unit

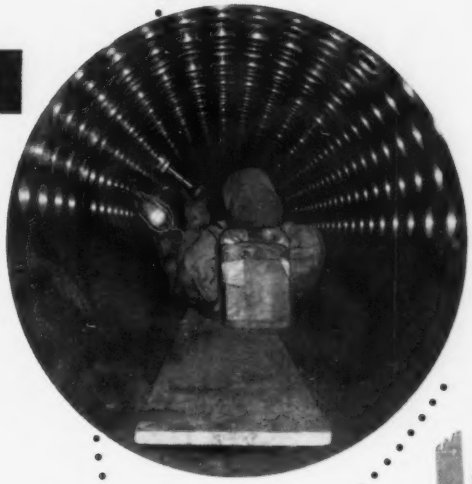
INDIANAPOLIS WATER WORKS
BROS W1 Unit

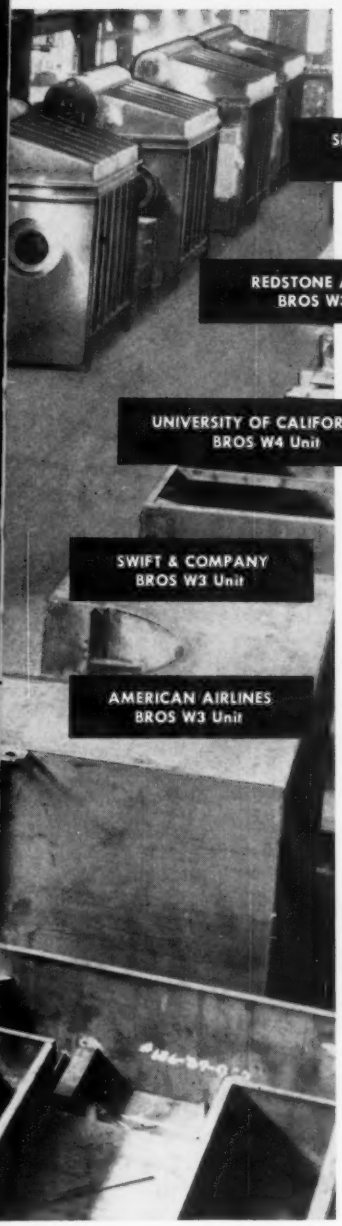
NATIONAL SALES AND SERVICE

BIRMINGHAM—Palmer & Lawrence
BISMARCK—Lignite Combustion Engineering Corp.
CHICAGO—D. H. Skeen & Company
DALLAS—Mechanical Specialty Co.
DENVER—The Lucas Engineering Co.
DETROIT—Wayne Boiler & Equip. Co.
DULUTH—Williams-Swanson Co.
GRAND RAPIDS, MICH.—Clay C. Zuiderhoek
INDIANAPOLIS—Young-Streeter Co.
KANSAS CITY, MO.—D. E. Maskill Co.
LOS ANGELES—Frank M. Beeson
LYNCHBURG, VA.—The Campbell King Co.
NASHVILLE—Power Specialty Co.
NORWOOD, N. J.—Eastern Power Equipment Corp.
OMAHA—Pioneer Pipe & Supply Co.
RIPON, WIS.—Yates Equip. & Supply Co.
ROCHESTER, N.Y.—Automatic Combustion Equip. Co.
PORTLAND, ORE.—Robert E. Wiegand
SALT LAKE CITY—James J. Burke Co.
SEATTLE—Arthur L. Benny
TULSA—Bagwell Company









SKELLY OIL COMPANY
BROS W3 Unit

REDSTONE ARSENAL
BROS W3 Unit

UNIVERSITY OF CALIFORNIA
BROS W4 Unit

SWIFT & COMPANY
BROS W3 Unit

AMERICAN AIRLINES
BROS W3 Unit

Add the advantages—you'll agree that the BROS Packaged Boiler design keeps your production or processing costs low while providing top operating efficiency, economy and flexibility to provide for future steam needs. Add the advantages and you'll understand why BROS Packaged Boilers, products of 76 years' experience, are favorites in industry today.

For example, completely shop-assembled, BROS Packaged Boilers feature:

(1) horizontal gas flow with tubes and baffles arranged vertically to minimize soot accumulating surface. The boiler is compact with small cross section, providing low over-all height and space-saving length and width.

(2) Also vitally important, the floor, sides and roof of furnace are of tangent tube construction. And rear refractory wall is protected with waterwall surface.

(3) To aid housekeeping, liberal drum sizes and short soot blower elements eliminate special equipment for soot removal. Valve-in-head soot blowers are standard equipment for all oil-fired units.

Capacities range from 8,500 to 50,000 lbs. steam per hour at standard pressures up to 250 psi. Special units for higher pressures are available. Ready to go "on-the-line" with simple connections. Your choice of manual, semi or fully automatic controls. Fired with oil or gas or combination of both.

See your nearest BROS Power Dealer. Ask him to give you all of the cost-saving advantages of BROS Packaged Watertube Boilers.

BROS

BROS *Incorporated*

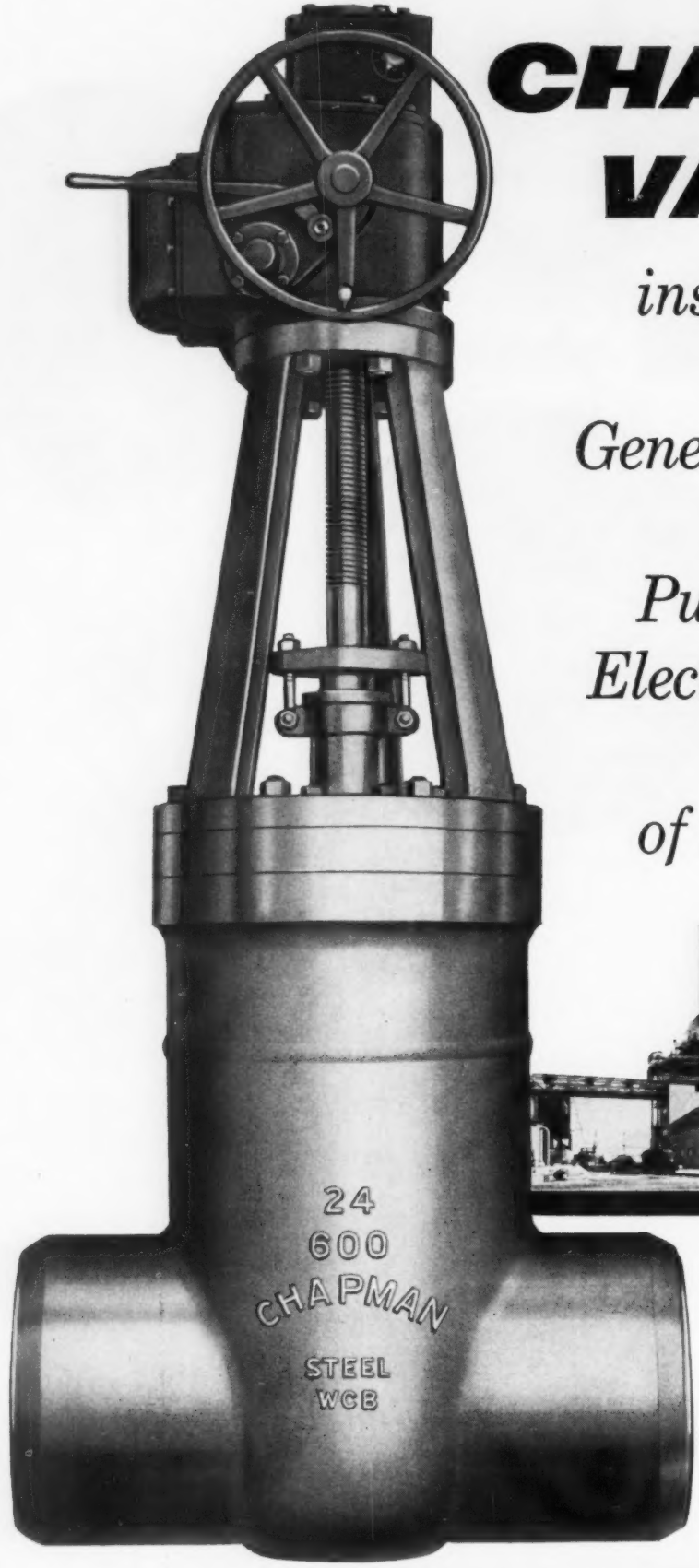
POWER DIVISION

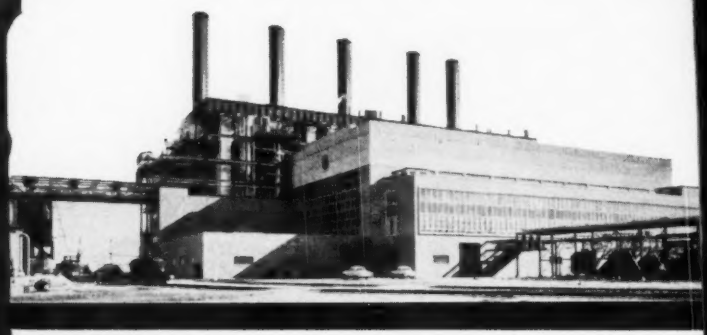
1057 TENTH AVE. S.E.
MINNEAPOLIS 14, MINNESOTA

Keeping step with a forward step

CHAPMAN VALVES

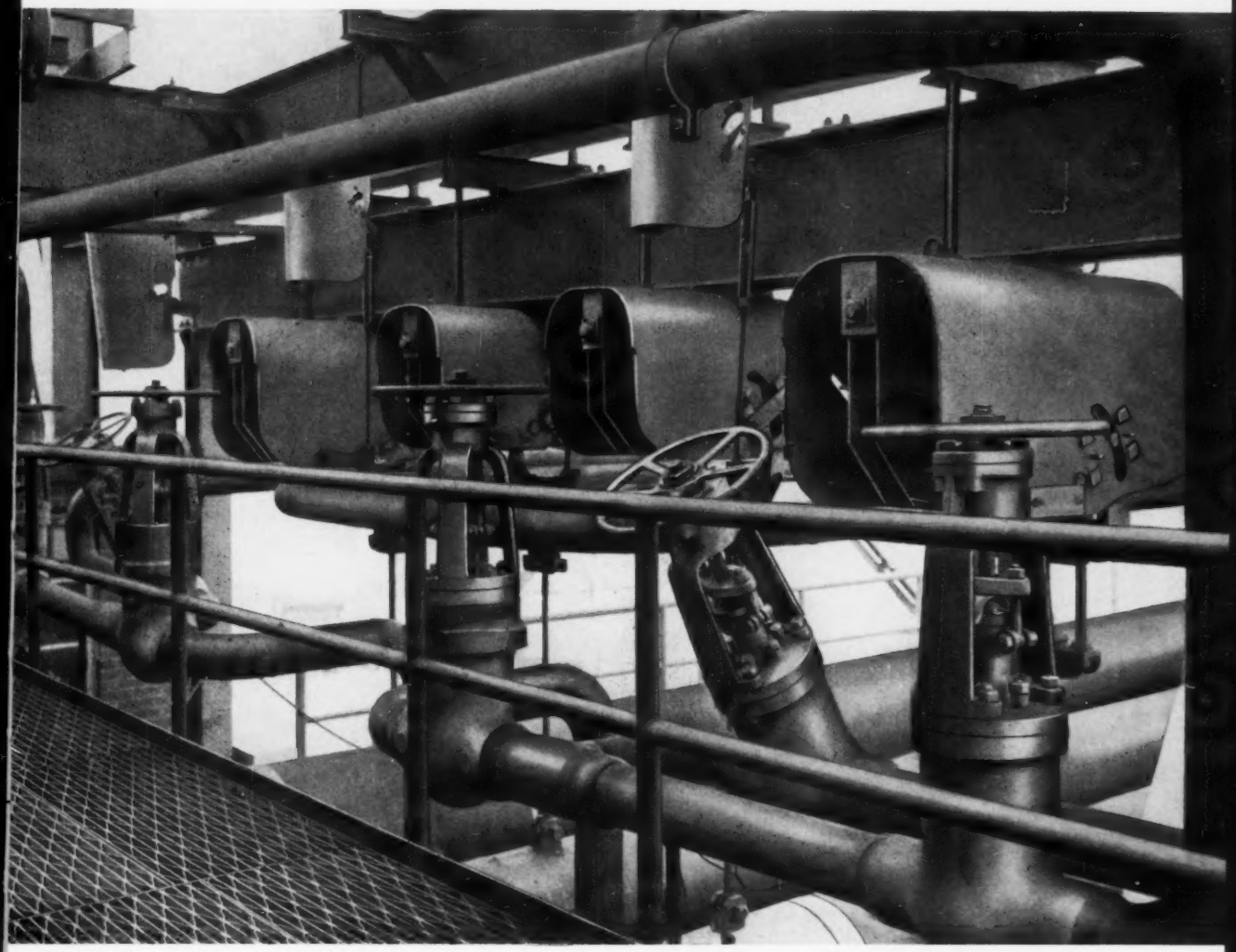
installed in the Linden Generating Station for the Public Service Electric and Gas Company of New Jersey





A Chapman high pressure alloy steel gate valve of the type specified for Linden. This valve has pressure seal body-bonnet connection, welding ends, and is equipped for motor operation.

in Steam Power Plant Engineering



Chapman valves in service at the Linden Station.

It's new. It's modern. And it's now in operation. The Linden Generating Station represents a forward step in steam power plant engineering. Designed by the Electric Engineering Department of the Public Service Electric and Gas Company, the plant was built by United Engineers and Constructors Incorporated. The size of equipment, the magnitude of the throttle and process flows, and high operating economy were involved. They sought and got lower operating costs with no increase in steam conditions.

Valves, of course, were also involved. Chapman engineers were prompt to work with the designers and builders of this new station and produce valves that fully met the specific requirements of each application. These included valves for high pressure heater inlets, valves for controlling atomizing steam to desuperheaters, valves for handling high pressure process steam and many others.

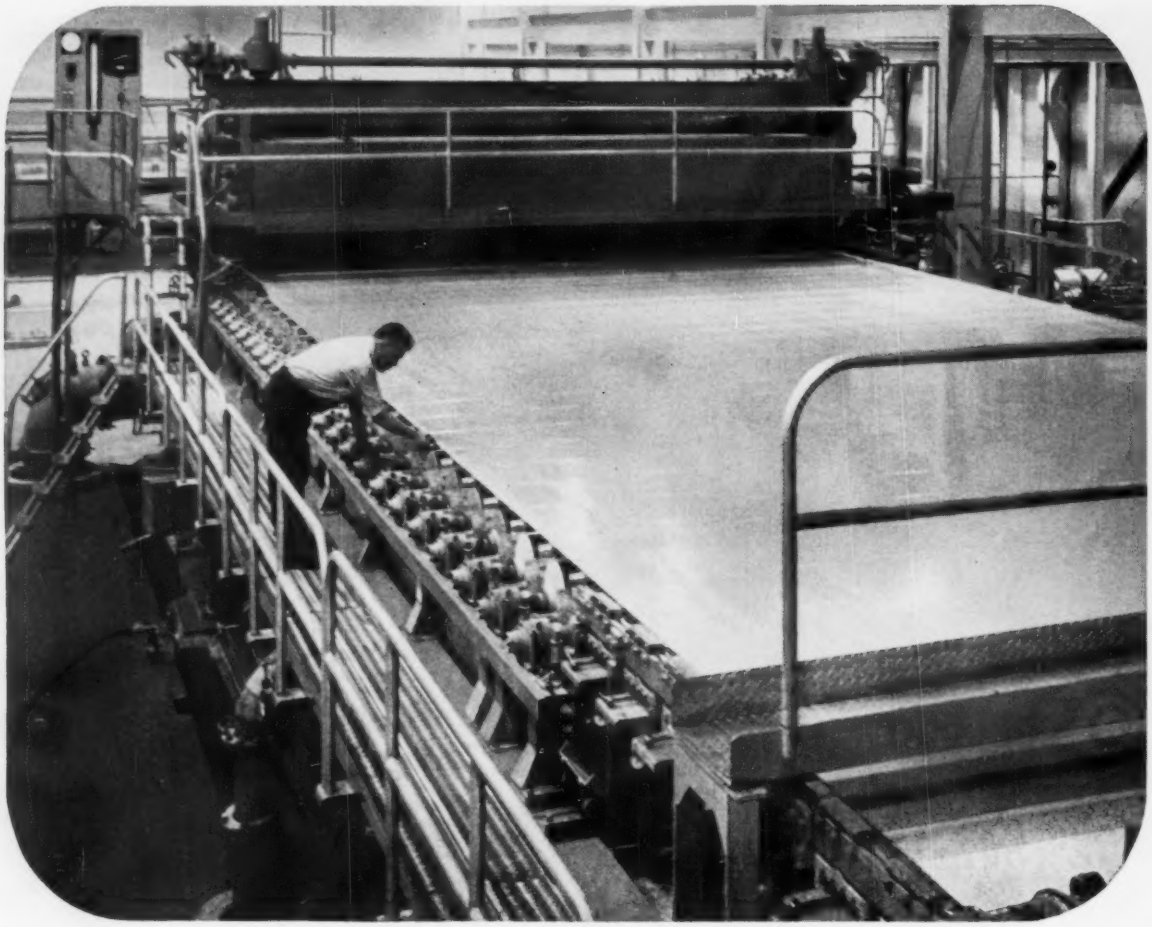
No matter what *your* valve requirements might be, it always pays in the first instance and *in the long run*, to talk with a Chapman engineer. Write, and we'll be promptly at your service.

The **CHAPMAN** *Valve Manufacturing Company*

INDIAN ORCHARD, MASSACHUSETTS

For over 75 years, Chapman engineers, metallurgists, manufacturing and testing facilities have concentrated on meeting usual and advanced requirements for power plants, water works, chemical plants, refineries and industrial use.

ION EXCHANGE RESINS condition boiler feed



Wet end of Fourdrinier paper machine at a Minnesota and Ontario Paper Company Mill

MINNESOTA and ONTARIO PAPER COMPANY needs water of low mineral content for power generation and processing... uses AMBERLITE Ion Exchange Resins

It takes a lot of water to run a paper mill, not only as an actual ingredient in paper making, but also for the steam necessary for power generation and for cooling paper machine condensate.

At Minnesota and Ontario Paper Company in International Falls, Minnesota, the feed water to the boiler—rated at 240,000 lbs. per hour, 1290 psig.—must be deionized. This is accomplished by passing the feed water through 1) two parallel beds of AMBERLITE IR-120, a strongly acidic cation exchange resin operating in the hydrogen cycle, 2) a vacuum deaerator, 3) and through two parallel beds of AMBERLITE IRA-400, a strongly basic anion exchange resin. The water has a conductivity of only 1.5 to 3 micromhos, with a silica content of less than .015 ppm. Deionized water requirements vary from 100 to 300 gallons per minute.

Perhaps your organization, too, has a water conditioning problem. If so, your engineering company specializing in water conditioning is qualified by experience to recommend how AMBERLITE resins can best serve your particular needs. For detailed information about AMBERLITE resins, write for the booklet, "If You Use Water."

AMBERLITE is a trade-mark, Reg. U.S. Pat. Off. and in principal foreign countries.

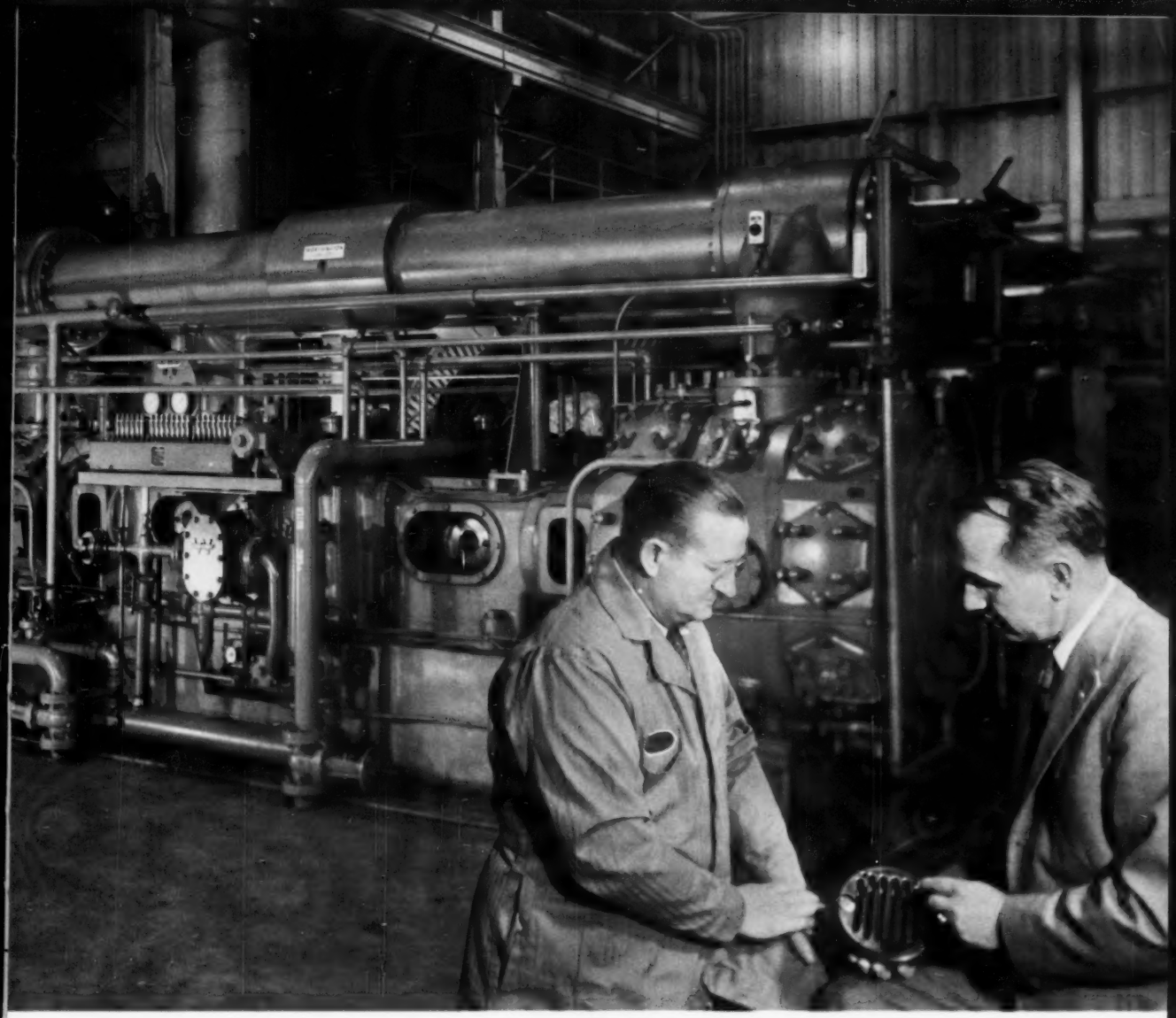
Chemicals for Industry

ROHM & HAAS COMPANY

THE RESINOUS PRODUCTS DIVISION

Washington Square, Philadelphia 5, Pa.

Representatives in principal foreign countries



User-survey shows – in all operating categories

FEATHER VALVE VOTED BEST

Simplest Construction:

- FEATHER VALVE
- VALVE A
- VALVE B

Most Efficient:

- FEATHER VALVE
- VALVE A
- VALVE B

Lowest Maintenance:

- FEATHER VALVE
- VALVE A
- VALVE B

Quietest:

- FEATHER VALVE
- VALVE A
- VALVE B

A recent survey among compressor-users showed this marked preference in all four operating categories for the amazing Feather* Valve. The Worthington Feather Valve is the lightest, fastest-acting compressor valve available. Because of its lightness and flexibility it provides very sharp action with virtually no slip or back-flow. And because it works with no impact . . . has no buffer plates or cushioning devices . . . it is all but indestructible, assures long-life with negligible maintenance costs.

To get the most in performance when you buy your next compressor, specify Worthington with the rugged Feather Valve feature. Worthington Corporation, Harrison, N. J.

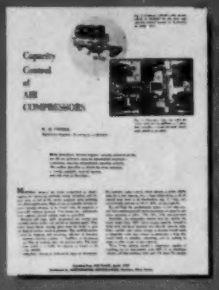
*REG. U.S. PAT. OFF.

WORTHINGTON

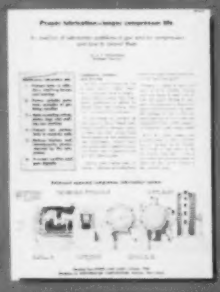
1. Reciprocating Compressors

2. Compressor Performance Characteristics

3. Selection of Heavy Duty Compressors



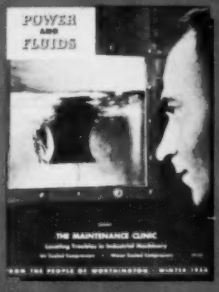
4. Capacity Control



5. Compressor Lubrication

6. Compressed Air Piping

7. Compressor and Engine Foundations

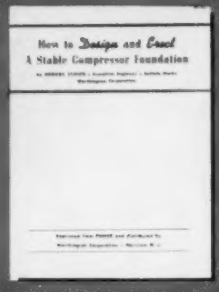


8. Compressor Maintenance Clinic

9. Accessories and Protective Devices

10. Compressed Air for Ford's Cleveland Foundry

11. Picking Compressors for Air Soot Blowing



12. How to Erect a Stable Compressor Foundation

WORTHINGTON CORPORATION
Section 36-2 Harrison, New Jersey

Please send me articles checked:

☐ 1	☐ 4	☐ 7	☐ 10
☐ 2	☐ 5	☐ 8	☐ 11
☐ 3	☐ 6	☐ 9	☐ 12

☐ *I would like to discuss a compressor application. Please have an engineer call.*

NAME_____

COMPANY_____

ADDRESS_____

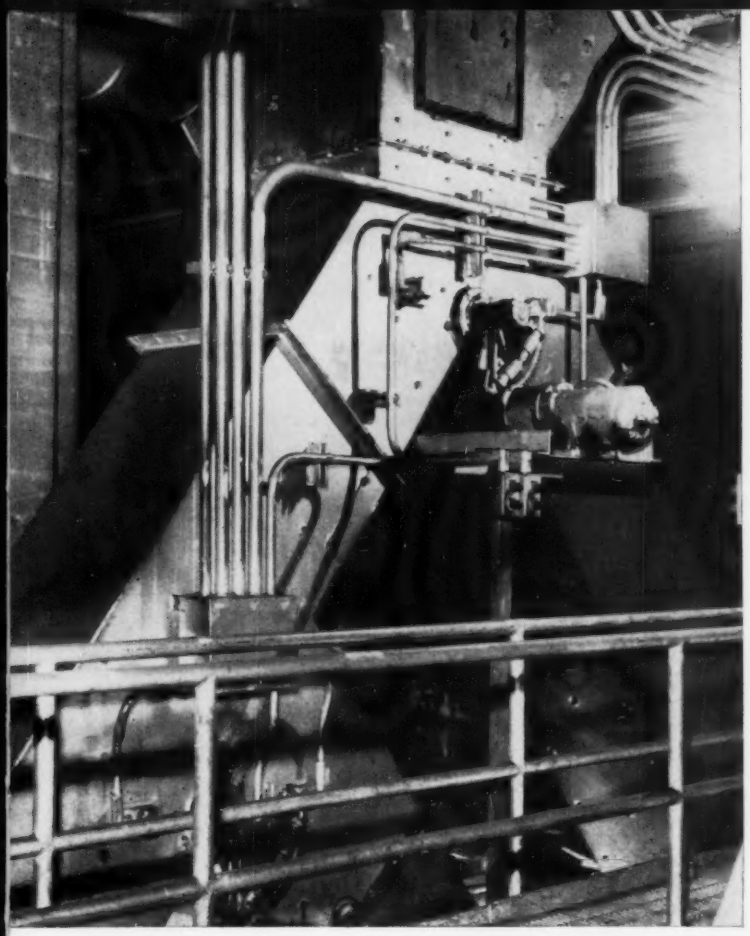
CITY AND STATE_____

PLAIN TALK

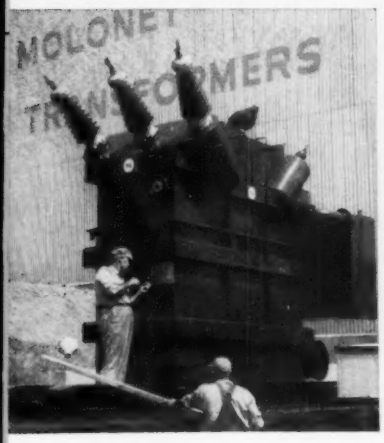
on water-cooled compressors

For your free copy of any of these informative articles on water-cooled compressors, write to Worthington Corporation, Harrison, New Jersey. In Canada: Worthington Canada Ltd., Brantford, Ont.

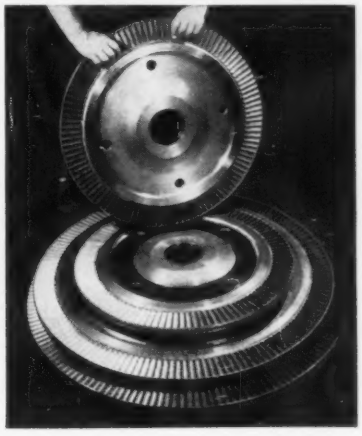
WORTHINGTON



Longer life for coal chute liners. USS "T-1" Steel's high resistance to impact abrasion has doubled, tripled and even quadrupled the life of chutes handling highly abrasive materials such as coal, cinders and ore. "T-1" Steel furnished to 321 minimum Brinell has been particularly effective in this service.



Over a ton of weight saved on this lighter-weight portable transformer. Shell thickness was reduced from ⅜ to ¼ inch by designing to USS "T-1" Steel's greater strength.



60 per cent savings in material costs were realized by making these small turbine rotor discs from USS "T-1" Steel which has a yield strength of 100,000 psi minimum.

How USS "T-1" Steel is used for **cost reduction** in power plants

Power plants are caught in the cost squeeze like every other industry. But if you can make your equipment last longer by using better steel, you can save a substantial number of dollars.

USS "T-1"* Constructional Alloy Steel has an amazing combination of properties that can cut costs in numerous ways:

- **Minimum yield strength of 100,000 psi NRM—permits stronger construction with large savings in weight.**
- **Outstanding resistance to impact abrasion—increases equipment life.**
- **Exceptional toughness even at 50° below zero temperature—reduces maintenance costs.**
- **The 4 times greater atmospheric corrosion resistance increases service life.**
- **Ready weldability and formability—reduces construction costs.**
- **Lower transportation charges—because fewer tons are shipped to job sites.**

All this means that materials handling equipment can last two or three times longer when built of USS* "T-1" Steel. And wherever impact abrasion is particularly severe, USS "T-1" Steel may be furnished quenched and tempered to 321 minimum Brinell hardness for maximum performance.

Other savings have shown up in a variety of ways—lighter construction, lower fabrication costs, smaller foundations, considerably less maintenance, fewer outages, less freight and lower erection costs.

Consider USS "T-1" Steel for use in handling and storage equipment, pressure vessels, scroll cases, penstocks. Write for our book, *USS "T-1"*, which gives the complete story. United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

Immediate Delivery. Our new continuous plate heat-treating line offers solution to your delivery and quality requirements. Therefore, there is no tonnage restriction on plates, and as little as three tons of "T-1" Steel bars may be purchased directly from the mill.

USS

*TRADEMARK

United States Steel Corporation – Pittsburgh
Columbia-Geneva Steel – San Francisco
Tennessee Coal & Iron – Fairfield, Alabama
United States Steel Supply – Steel Service Centers
United States Steel Export Company

United States Steel

SAVANNAH RIVER

MISHAWAKA

SHIPPINGPORT

OAK RIDGE

ARGONNE NAT'L LAB

U.S.S. SEAWOLF

PADUCAH

U.S.S. NAUTILUS

BROOKHAVEN NAT'L LAB

HANFORD WORKS

KNOLLS ATOMIC

At this moment K&M precision valves are on-stream in some of the "hottest" lines in the country. It is their job to keep a sure and steady hand on the flow of radioactive fluids in shipboard and land-based installations. It is K&M's job to make certain that each of these valves meets the exacting specifications for this most critical service. To do it, K&M uses radiographic inspection, high-temperature helium leak testing and more than eight hundred separate dimensional check-outs. You, too, can benefit from K&M's unfailingly high standards of quality and craftsmanship the very next time you consider the purchase of a valve for fluid control. The thing to remember is the name: Kieley & Mueller, Inc.

K&M

diaphragm control valves

Our 79th Year

S.A. 1702

KIELEY & MUELLER, INCORPORATED

Oldest Pressure and Level Control Valve Manufacturer
64 Genung Street, Middletown, New York

compact, efficient,
mass produced for
quick delivery

a new P-K product line you'll want to know about– and the new P-K catalog that describes it

–YOURS FOR THE ASKING!

The P-K Type DW convertor and water heater is for use below the water line of steam or hot water boilers. It is engineered for high heat transfer and low maintenance and the design is standardized for a complete selection of sizes – capacities – temperature ranges – for industrial and domestic "water to water" heat applications.

Mail the coupon now for complete description, including capacity and dimensional tables of sizes available for fast delivery. The Patterson-Kelley Co., Inc., 2508 Warren St., East Stroudsburg, Penna.

Patterson-Kelley Co., Inc.
2508 Warren St., East Stroudsburg, Penna.
Send me a copy of Bulletin No. 6050 on the new P-K Type DW convertor and water heater.

*Name*_____ *Title*_____

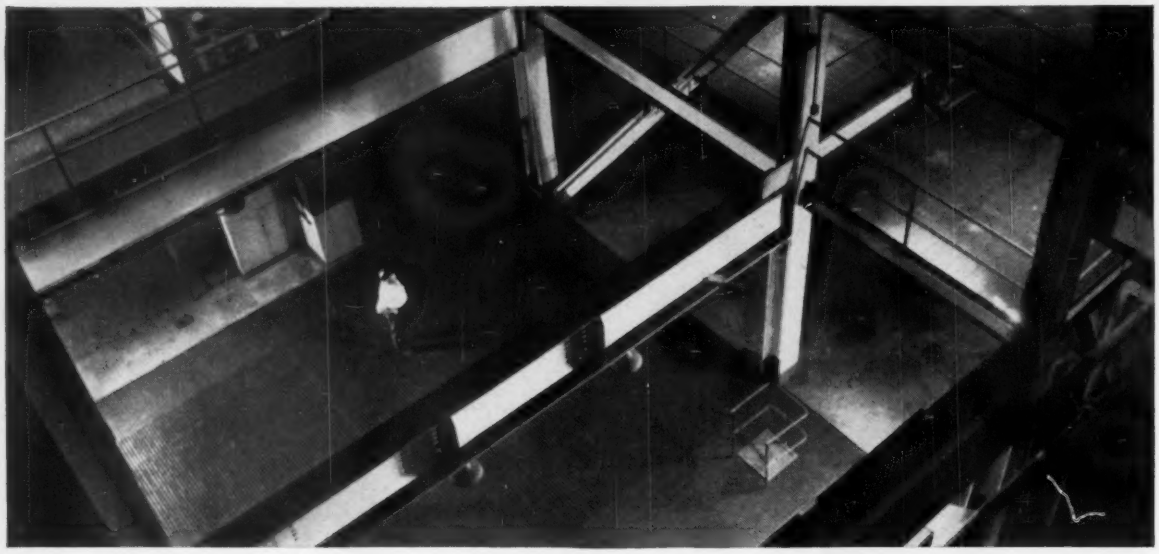
*Company*_____

*Address*_____

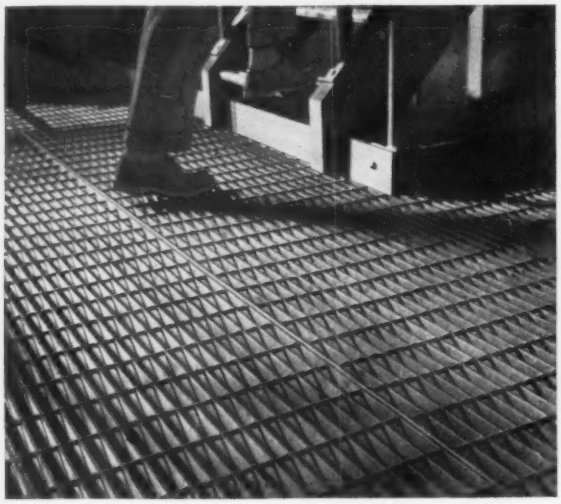
*City*_____ *Zone*_____ *State*_____

Patterson Kelley
Water Heater Division
Storage Water Heaters • Instantaneous Heaters Convertors • Fuel Oil Heaters

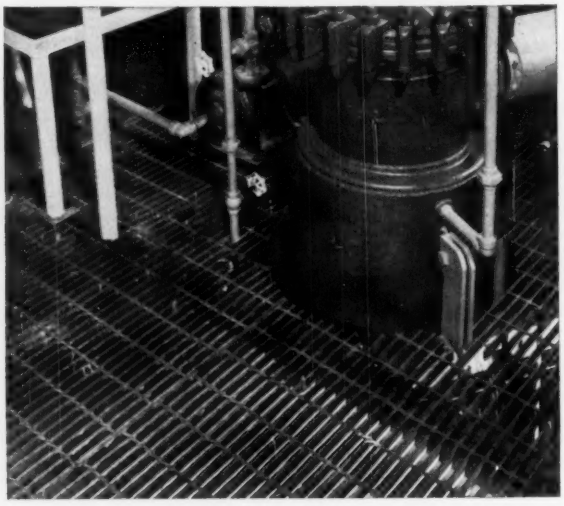
designed for flexibility...**Electroforged® for strength**
Blaw-Knox Grating fits modern plant needs



More floor space . . . Platforms, mezzanines and loading docks made of flexible Blaw-Knox Electroforged Steel Grating increase storage space, enlarge feeder areas. Easily installed, and easily adapted to changing layouts.



Safer walking . . . on *non-slip* floors, walkways and stairs, Blaw-Knox Electroforged Steel Grating provides rigid one-piece construction and features the twisted cross bar to make every step a safe step.



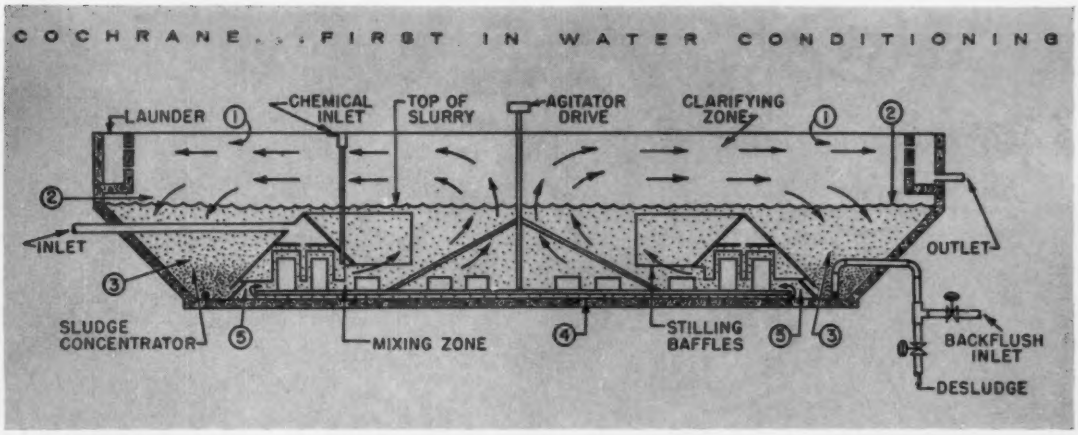
Fits anywhere . . . around pipes, beams and machinery to provide a neat, easy-to-maintain surface. There's nothing to wear, patch or catch dirt. And Blaw-Knox Grating admits more light and air for ideal working conditions.

Write for Bulletin 2527 and see how Blaw-Knox Grating can be custom fabricated to meet your plant improvement specifications.

BLAW-KNOX

BLAW-KNOX COMPANY

Equipment Division
Department Y, Pittsburgh 38, Pennsylvania



A Cochrane solids contact reactor is designed to provide the ultimate in clarification

Cochrane suspended solids contact coagulating and softening clarifiers are packaged units that combine a mixing zone at the bottom with a clarifying zone above.

A bottom agitator in the mixing zone keeps old precipitates in constant suspension. Thorough mixing and contact between the old and new precipitates is thus assured. This results in a more complete reaction with a minimum in chemical requirements and retention time. In the clarifying zone the water is effectively separated from the slurry precipitates and clarified.

The Cochrane reactor design is unique in its baffle and agitator arrangement, as follows:

① Radial *Horizontal* Flow—*Not Upflow*. Velocity decreases from center to launder. Slurry particles separate more efficiently from horizontal flow than from upflow.

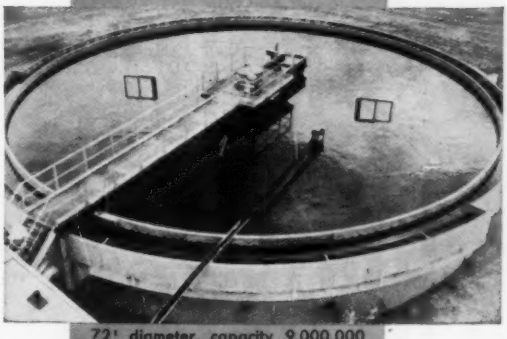
② Slurry flow is *downflow* in clarifying zone below collecting launders—*not upflow*—thus preventing carryover of turbidity into effluent.

③ Sludge settles only in annular *concentrator* outside of mixing zone. Maximum concentration results because no turbulence is present. This feature saves wastage of water in desludging.

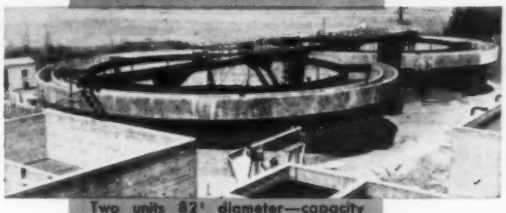
④ There is no premature loss of slurry strength in mixing zone because no sludge settles on the floor of mixing zone.

⑤ Turbulence in mixing zone assures excellent mixing. A large, full-diameter agitator causes centrifugal outward flow, against the diverting baffle in front of the outer port and turns flow inwardly towards central port.

72' diameter, capacity 9,000,000 GPD located in Georgia.



72' diameter, capacity 9,000,000 GPD located in Texas.



Two units 82' diameter—capacity 20,000,000 GPD located in Washington.

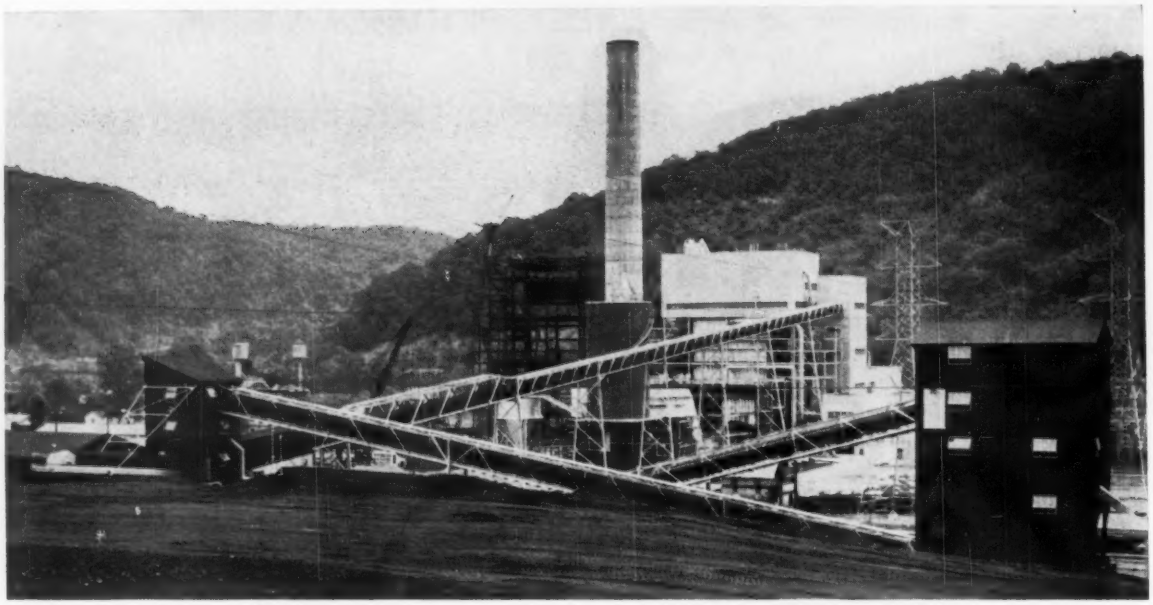
Cochrane
CORPORATION
3106 N. 17TH STREET, PHILADELPHIA 32, PENNA.
NEW YORK • PHILADELPHIA • CHICAGO

Cochrane Water Conditioning Ltd., Toronto 4, Montreal 1, Winnipeg 1, Canada.

Representatives in Thirty Principal Cities in U.S., San Juan, Puerto Rico; Honolulu, Hawaii; also: Paris, France; La Spezia, Italy; Mexico City, Mexico; Havana, Cuba; Caracas, Venezuela; San Diego, Chile; Manila, Philippine Islands.

Pottstown Metal Products Div.—Custom built carbon steel and alloy products

Demineralizers • Hot Process Softeners • Hot Zeolite Softeners • Dealkalizers • Reactors • Deaerators • Continuous Blowoff Systems Condensate Return Systems • Specialties



POWER HOUSE COAL HANDLING BY H&P

For dependable, low-cost handling, the West Penn Power Company *again* relies on Heyl & Patterson. At the new Armstrong Power Station, coal is unloaded by a rotary railroad car dumper and simultaneously weighed on the dumper platen by an electronic scale (Pat. Pend.). Belt conveyors then carry the coal to the Bradford Breaker and subsequently either to storage or to the Power House bunkers. While on its way, a predetermined quantity of coal is crushed and sampled. All this equipment including dumper, breaker and sampler was designed and built by Heyl & Patterson.

H & P Coal Handling Systems are carefully engineered for specific requirements and provide flexible yet economical performance. They are known for low maintenance requirements even when operating continuously. In short, THEY BEAR THE MARK OF QUALITY—based on over 70 years of experience.

An H & P Contracting Engineer is at your disposal to assist in developing the most practical method of handling your coal out of barges or railroad cars to and from stock pile and into your bunkers.

H & P is equipped to furnish such complete installations all the way from design to erection.

When Experience Counts—
Count on Heyl & Patterson!
Since 1887

Heyl & Patterson INC.

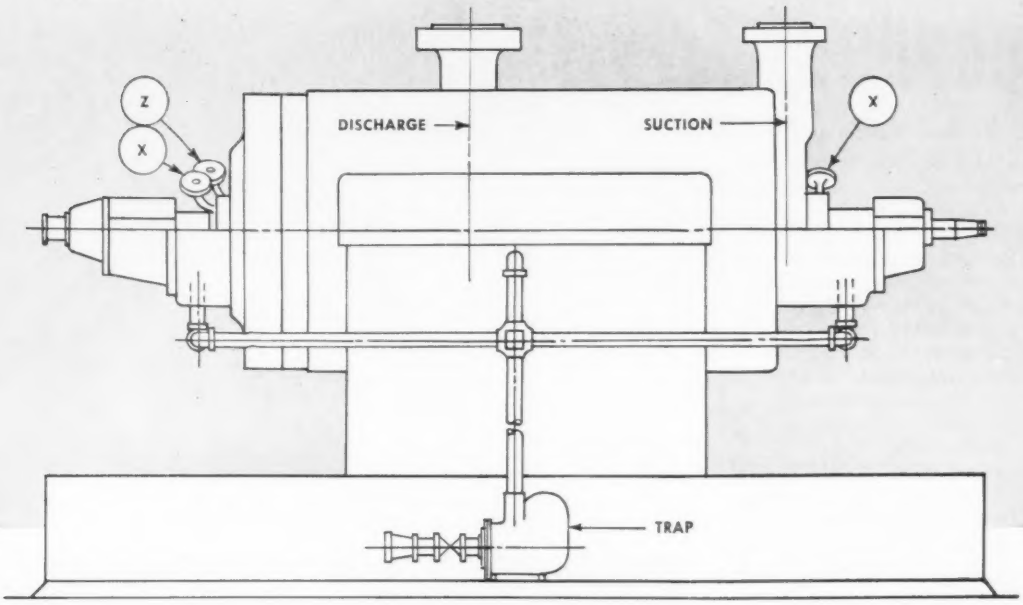
55 FORT PITT BLVD., PITTSBURGH 22, PA., COurt 1-0750

Arrangement of packingless sealing shows low-maintenance provisions. Condensate is piped to each stuffing box through line X. Condensate flows through an inner and then an outer serrated bushing. Drip catcher gathers condensate at each end — permits condensate to flow by gravity to a collecting trap. Condensate leakage is drawn back into the system by means of a condenser vacuum. Where no vacuum is present, an overflow pipe keeps leakage from entering the bearing bodies.

Line Z takes the high pressure bushing leakage back to the pump suction or to a heater. A needle valve following the trap will control flow back to the condenser.

Optional Sealing Arrangements

In addition to packingless seals, Allis-Chalmers offers standard packing, condensate bleed-in bleed-off arrangement, or mechanical seals — depending on your specific requirements.



PACKINGLESS SEALS

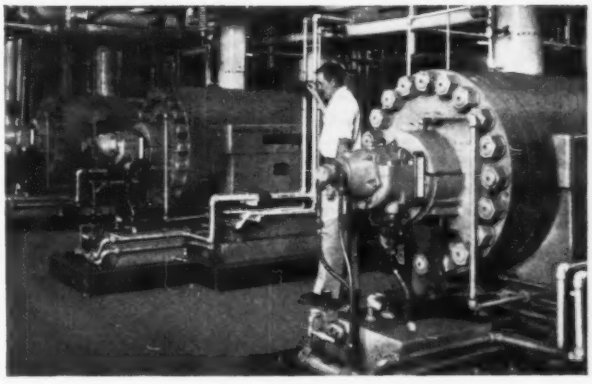
in ALLIS-CHALMERS barrel-type pumps

require no operator maintenance

Proven by performance in numerous power plants, the packingless seal arrangement available in Allis-Chalmers pumps means new station-operating economies. Here's why:

- Operator maintenance of stuffing box eliminated.
- No cooling water required for jacket and gland.
- Selection of smaller heater drain pumps often permitted.

Coupled with this low-maintenance design is the ultimate in efficiency that makes A-C barrel-type boiler feed pumps the most modern power plant pumps available. Contact your A-C representative or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.



ALLIS-CHALMERS A-C ALLIS-CHALMERS

A-5544

"Used many makes of turbines... PREFERS COPPUS"

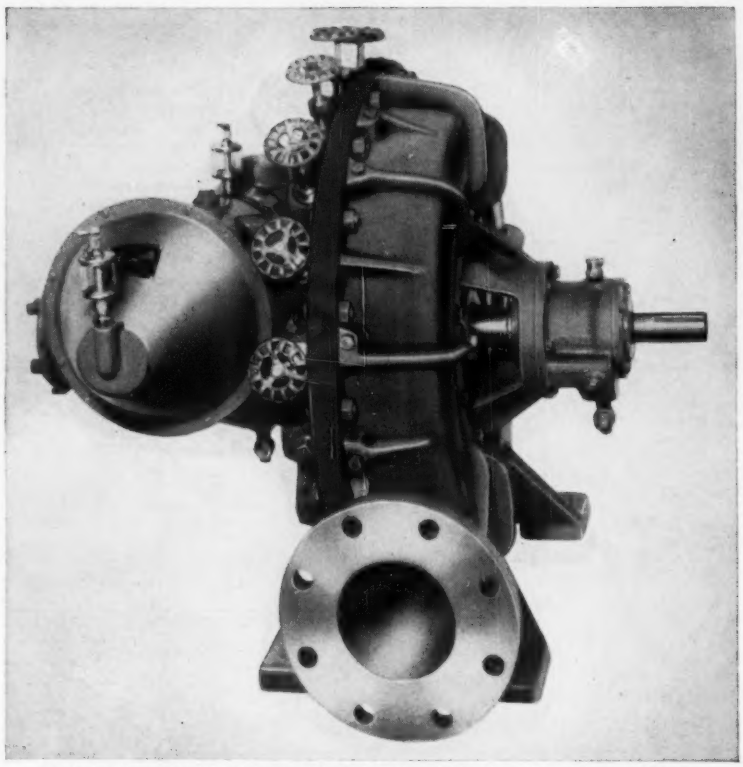
If you want to know about turbine performance, ask an *operator*. He *knows*. And, in the words of one of them:

> "I have had occasion in the past to operate many makes of turbines. The plant in which I am now employed is almost entirely Coppus equipped on our auxiliary equipment. I find your turbines most satisfactory and would like to congratulate you on your design."

Whether you use a Coppus with a regular wheel or wide bucket "L" type you get these *proven* features:

- Turbines rated close to your hp requirements from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.
- Coppus Steam Turbines ranging from 150 hp down to fractional in 6 frame sizes, *make turbine dollars go farther*. Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
168 Park Avenue, Worcester 2, Mass.
Sales offices in THOMAS' REGISTER



This is the reliable Coppus Turbine furnished with either a regular wheel or wide bucket "L" type wheel.

This wide bucket "L" type wheel is a new development for use where low water rate is essential

This is the regular wheel used on Coppus Turbines which have been so highly satisfactory throughout industry.

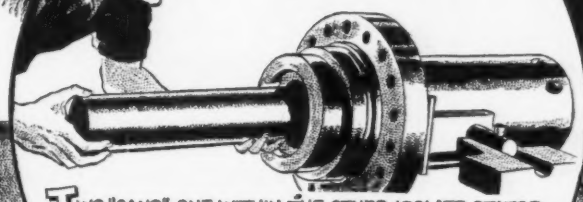
COPPUS "BLUE RIBBON" TURBINES

POWER POINTERS

Tubing enough to top U.S.A.F. altitude record by 3.1 miles

END TO END, MONEL* NICKEL-COPPER ALLOY TUBES IN AN EASTERN POWER COMPANY'S TWO NEW FEEDWATER HEATERS WOULD REACH 27 MILES ABOVE SEA LEVEL—OVER 3 MILES HIGHER THAN THE UNOFFICIAL ALTITUDE RECORD FOR POWERED AIRCRAFT...7 MILES ABOVE THE NEW RECORD FOR BALLOONS. THE HIGH STRENGTH OF CORROSION-RESISTING MONEL ALLOY PERMITS USE OF RELATIVELY LIGHT 17-GAUGE TUBING IN HANDLING FEEDWATER AT PRESSURES OVER 2000 PSI AND BLEED STEAM TEMPERATURES UP TO 820°F...SPEEDS HEAT TRANSFER.

Secret of seal-less pump: the metal that acts like air



TWO "CANS", ONE WITHIN THE OTHER, ISOLATE STATOR AND ROTOR OF THIS LEAK-PROOF SEAL-LESS PUMP FROM CIRCULATING FLUIDS. "CANS" ARE MADE OF INCONEL* NICKEL-CHROMIUM ALLOY. MAGNETICALLY, INCONEL ALLOY BEHAVES LIKE THE AIR GAP IN AN ORDINARY ELECTRIC MOTOR, CREATES NO MEASURABLE INTERFERENCE WITH MAGNETIC FLUX...HAS NO EFFECT ON MOTOR EFFICIENCY.

Trumpet valve cycles up to 8 times per second in "Flight of the Bumble Bee"

FIRST COUSINS TO INDUSTRIAL COMPRESSED AIR VALVES, TRUMPET VALVES MUST RESPOND TO HIGH SPEED FINGERING. TO PREVENT STICKING, WEAR AND CORROSION—ENEMIES OF TRUMPET AND INDUSTRIAL VALVES ALIKE—A FAMOUS MANUFACTURER MAKES VALVE PISTONS FOR HIS TRUMPETS OF MONEL* NICKEL-COPPER ALLOY. CORROSION-AND-WEAR RESISTANT MONEL ALLOY IS READILY MACHINED, BRAZABLE AND TAKES A HIGHLY POLISHED FINISH.

STUMPED BY A METAL PROBLEM?

PERHAPS GETTING TOGETHER WITH INCO'S MECHANICAL ENGINEERING SECTION WILL HELP YOU COME UP WITH AN ANSWER. FOR A PRELIMINARY BRIEFING, WRITE

Department PO

FOR INCO BULLETINS COVERING ENGINEERING PROPERTIES OF INCONEL* AND INCONEL 'X'* ALLOYS AND MONEL* AND 'K' MONEL* ALLOYS.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO Nickel Alloys

*Registered trademark

These 5 "tips" can help you end sump pumping problems *once and for all*

Here are 5 ways to prevent sump pumping trouble before it starts *and* cut maintenance time—with Goulds Fig. 3171 vertical centrifugal sump pump.

1. Put the pump at the proper depth without paying the extra cost for special shaft lengths and pipe columns. Goulds Fig. 3171 fits any pit from 2 to 20 feet deep—comes in standard lengths of 6 inch increments.

2. Maintain pump alignment permanently by means of male and female fits on Goulds Fig. 3171.

3. Prevent damage by fumes, weather, moisture with these features of the Fig. 3171: completely sealed-in upper bearing; Falk all-steel couplings; special vapor-proof construction (upon request).

4. Make external adjustments for impeller clearance with Goulds Fig. 3171—to save time, trouble. Replace upper bearings without disturbing pump or piping merely by removing the motor and coupling from above.

5. Adapt to changing pit depths without ordering a whole new unit. You can adapt this pump *in the field* for new depth or pump ratings simply by ordering a few new parts.

You can get Goulds Fig. 3171 as a single or duplex unit—completely assembled with sump cover—for wet or dry pits, with capacities to 1080 GPM, heads to 290 ft. For more details, contact your Goulds dealer, or write for your copy of Bulletin 726.2.

GOULDS PUMPS, INC.

Dept. PO-88 Seneca Falls, N. Y.

Pat. Applied For

New RIDGID Hex Wrench

gives you Time-Saving, Positive, 4-Sided Grip on Hex Nuts, Square Nuts, Valve Packing Nuts, Unions, Gas Cocks

Here's the adjustable wrench you've always needed for hexes, squares and flatheads, rough or finished. Extra-useful on every job. No more skinned knuckles or rounded nut shoulders. New wide-open jaw goes on easy . . . won't slip off. 4-sided grip gives extra leverage. Stays to adjusted size during use.

Famous RIDGID heavy-duty construction with guaranteed housing. Narrow jaw design makes work easy in tight places even on thin nuts. Comfort grip I-beam handle has handy hang-up hole. The new RIDGID Hex Wrench gives you more for your money than wrenches costing twice as much. Try it, buy it at your Wholesaler's.

Available in 3 Sizes

- **No. 11, 3/8" to 3/4"**
- **No. 17, 5/8" to 1 1/4"**
- **No. 25, 1" to 2"**

The Ridge Tool Company • Elyria, Ohio, U.S.A.

for greater strength . . . easier assembly

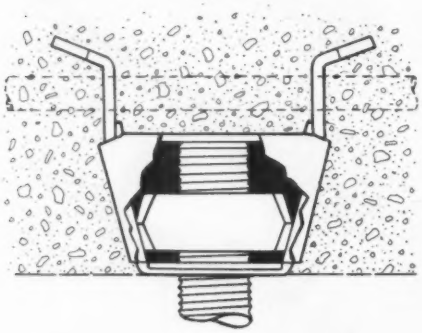
The new Grinnell Wedge Type Concrete Insert

Fig. 281

NEW design features give Grinnell's Wedge Type Concrete Insert (Fig. 281) greater load carrying capacity . . . 1200 lbs. for ⅝″ and ¾″ sizes, with a safety factor of at least 5 to 1.

Heavy gauge steel is die-formed into a wedge-shaped box housing. When load is attached to the inserted nut and rod assembly, ends of the elongated nut press on the wedge-slanted walls.

These walls, acting in compression with the concrete, provide strength unmatched in steel inserts of equal size.



Preassembly of the elongated nut on the rod makes quick assembly possible.

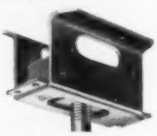
Installations can be made in quick time, too. Just a few turns of the rod tighten the nut rigidly in place. Slightly loosening the nut permits lateral adjustment along the full length of the slot, without fear of rod and nut falling out of the body.

Single body size accommodates four different interchangeable nut and rod sizes, to make ordering easier and installation simpler—especially where hanger rod sizes cannot be determined in advance of ceiling construction.

On your next project, specify Grinnell Concrete Inserts — either steel or malleable iron. Quality manufactured . . . *and priced right!* Grinnell Company, Inc., Providence 1, R. I.

CB-Universal Malleable Iron Concrete Insert (Fig. 282)

CB-Junior Malleable Iron Concrete Insert (Fig. 279)



Wrought Steel Concrete Insert (Fig. 280)

GRINNELL

PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic fire protection systems • Amco air conditioning systems

FOR TOUGH SEALING JOBS

where service conditions indicate Flexitallic Gaskets

In the field of high-pressure seals, engineers know and look for Flexitallic Blue, the blue-dyed Canadian asbestos filler that identifies the original Flexitallic Spiral-Wound Gasket construction.

- For operations where an effective seal is required to help protect an entire line or process
- For unusual joint stresses such as vibration, weaving, thermal and mechanical shock

In Flexitallic Gaskets, where the compression characteristics for a given pressure series are *always* related to the bolting load for that series, engineers get remarkable flexibility demanded in the application. Once the design is right for a given service, Flexitallic Gaskets are made under exacting mechanical controls to assure that manufactured gaskets conform to specification.

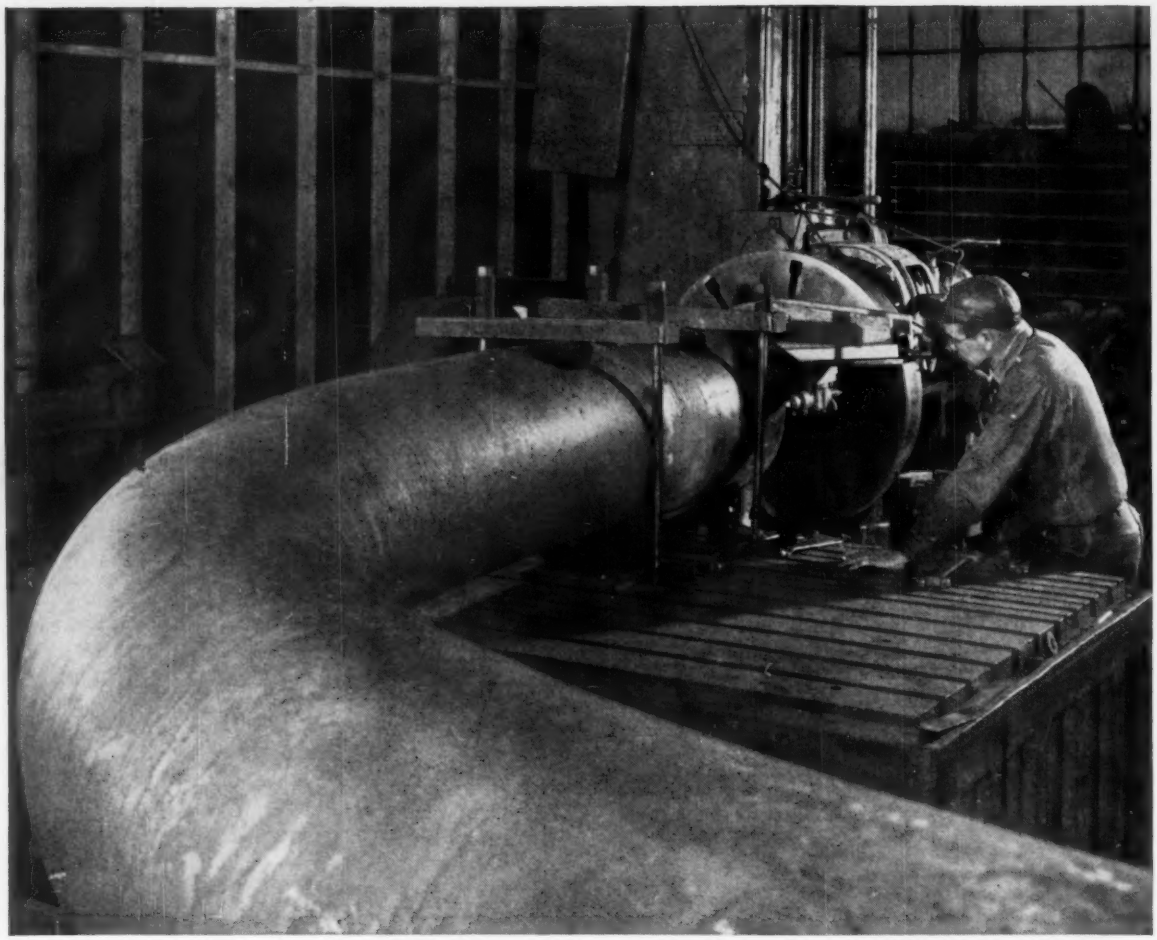
For the right combination of metal "spring" and non-metal filler, look for Flexitallic Blue . . . insist on Flexitallic Gaskets, exclusively spiral-wound construction since 1912.

FLEXITALLIC GASKET CO.
8th & Bailey Sts. Camden 2, N.J.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Flexitallic is a registered tradename. No one else can make a Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.



Boring mill cutting bevel on 18" diameter pipe with 3¼" wall in preparation for welding.

QUALITY CONTROL— key to superior performance

Dravo's Pipe Fabrication shops at Marietta, Ohio, are staffed by highly skilled men who have at their command the very latest in fabricating equipment, including a variety of devices for Quality Control checks. However, at Dravo, Quality Control goes beyond routine checks for compliance with applicable codes. Every step in the fabrication of piping is performed in accordance with procedures developed during Dravo's many years of experience, and is subject to rigid inspection.

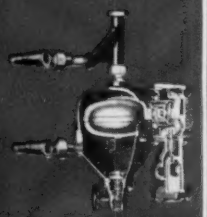
Here are some of the Quality Control checks which assure dependable performance in Dravo piping.

1. Radiographic examination of weld. Heavy walled piping may be subjected to several such checks during welding.
2. Heat treatment for stress relieving or normalizing under controlled furnace conditions.
3. Careful preparation of weld area. Dye-penetrant test may be used to assure sound metal at the weld area.
4. Dye-penetrant or magnaflux inspection where indicated.

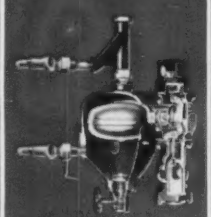
Dravo has the facilities for the fabrication of all kinds of piping. But whether routine or out of the ordinary, every job is held to Dravo standards. A Dravo Piping engineer will be glad to work with you on your next piping job. Write Dravo Corporation, Pittsburgh 22, Pennsylvania.

DRAVO
CORPORATION

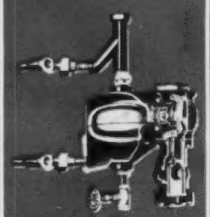
Blast furnace blowers • boiler and power plants • bridge sub-structures • cab conditioners • docks and unloaders • dredging • fabricated piping foundations • gantry and floating cranes • gas and oil pumping stations • locks and dams • ore and coal bridges • process equipment • pumphouses and intakes • river sand and gravel • sintering plants • slopes, shafts, tunnels • space heaters • steel grating • towboats, barges, river transportation



No. 47 Boiler Water Feeder for hand-fired steam boilers up to 5000 sq. ft.



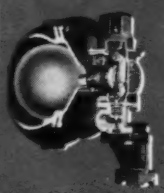
No. 47-2 Feeder Cut-off Combination for automatically-fired steam heating boilers up to 5000 sq. ft.



No. 147 Boiler Water Feeder — Like No. 47 but with higher feeding level for small process boilers.

No. 247-2—Feeder Cut-off Combination for small hot water space heating boilers.

No. 51-2 Feeder Cut-off Combination for automatically-fired heating boilers over 5000 sq. ft.

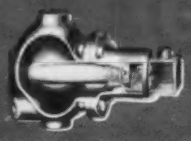


No. 53-2 Feeder Cut-off Combination — Like No. 51-2 but for higher pressures up to 75 lbs.

No. 67 Low Water Fuel Cut-off for low pressure automatically-fired steam boilers.

No. 63 Low Water Fuel Cut-off for hot water space heating boilers up to 50 lbs. pressure.

No. 69 "Built-in" Low Water Cut-off. One of many "built-ins" for installation in tapping provided in modern boilers.



No. 61 Low Water Fuel Cut-off for 1" equalizing pipe installation on low pressure steam boilers.

No. 767 Low Water Fuel Cut-off (with No. 14 blow-off) for installation in boiler opening.

No. 101 Electric Water Feeder — Operated by McDonnell two-switch cut-offs or liquid level switches.

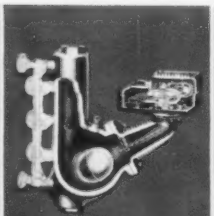
How many of these McDONNELL products do you know?

Check them over. You'll find a number of products you know well—but you'll also find many to solve those special problems that come up calling for liquid level controls, flow switches, and related equipment. It will pay you to know these and other products in the McDonnell FULL LINE. Ask for complete information.

McDONNELL & MILLER, *Inc.* 3506 N. Spaulding Ave., Chicago 18, Illinois

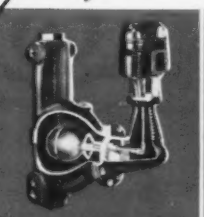
Doing One Thing Well

No. 150 Pump Control, Cut-off and Alarm Switch for boilers of any size up to 150 lbs. pressure.

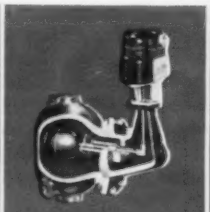


No. 157 Pump Control, Cut-off and Alarm — Like No. 150 but with integral water column.

No. 91 Pump Control, Cut-off and Alarm — New magnetic repulsion switching type for boilers of any size up to 150 lbs. pressure.

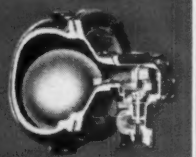


No. 191 Pump Control, Cut-off and Alarm — Like No. 91 but with integral water column.

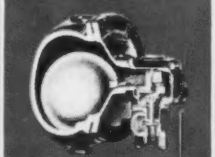


No. 92 Pump Control, Cut-off and Alarm — new magnetic repulsion switching type for pressures up to 250 lbs.

No. 192 Pump Control, Cut-off and Alarm — Like No. 92 but with integral water column.



No. 355 Large Capacity Float Valve—many uses on tanks, stills, receivers, etc.



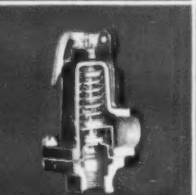
No. 4155 Feed Water Controller for multiple boiler jobs to divert pump discharge into proper boiler.

No. 65 Explosion-proof Electric Controller Underwriters' listed for hazardous locations.

No. 80 Float Switch. Three-wire high- or low-level alarm (or pump control) on oil storage tanks.

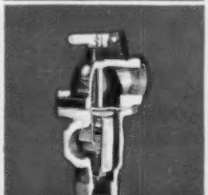
No. 21 Make-up Water Feeder for maintaining water level in receiving tanks—typical of series with flanges to fit existing tank openings.

No. 27T Make-up Water Feeder for external application on receiving tanks.



230 Series (ASME) Pressure Relief Valves for hot water boilers, tanks and heaters.

240 Series (ASME) Pressure Relief Valves for larger hot water boilers, tanks and heaters.



No. 201 Temperature Relief Valve for hot water tanks and heaters. A.G.A. tested, rated and listed.

202 Series Automatic Reseating Pressure and Temperature Relief Valves. ASME (HB) A.G.A.

P34 Series Flow Switch completes (or breaks) circuit when flow starts or stops. Max. psi, 100 lbs. Underwriters' Listed.

E-2 Series Flow Switch for higher pressure service; max. psi, 150 lbs. Completely waterproof construction.

Hall Industrial Water Report

VOLUME 6 AUGUST 1958 NUMBER 4

Almost 3,000 Billion Gallons of Water

are used each year by the U. S. chemical industry. For all U. S. industry the volume is more than 11,000 billion gallons per year. At this rate industry could drain Lake Erie in eighteen months.

Not all of this water requires treatment but a substantial portion does. Clarification may be all that is necessary for some uses. For others softening, silica removal or alkalinity adjustment may be required. Where very pure water is needed, demineralization may be indicated. Waste water may have to be treated before disposal or to save valuable materials for re-use.

Hall Laboratories has specialized on water problems for over thirty years. Experienced Hall engineers are ready to work with you on your water problems and to help you decide what treating procedures you need in your operations.

Weekly Shutdowns Eliminated

Two boilers in a pesticide manufacturing plant were shut down every weekend for mechanical cleaning. The hard well water used for boiler feed produced scale at a rapid rate despite attempts to prevent this with a "gadget" and later with a cure-all boiler compound.

Then the plant decided to let Hall Laboratories help. The Hall field engineer, with the cooperation of the operating men, soon established conditions in the boiler water which not only prevented new scale formation but removed the old scale at a controlled rate. Now the boilers have operated one year without a shutdown due to scale.

Retubed in Five Months

Three years ago a company operating chemical tank trucks installed a new package boiler for heating and steaming of dirty tanks. Against the recommendation of Hall Laboratories a gadget was purchased to protect the boiler from scale and corrosion.

Five months later a hurry-up call came for a Hall engineer. The boiler had had to be retubed because of corrosion.

Hall engineer M. E. Osmond immediately established water conditions which would protect the boiler. When it was inspected after five months' operation, everyone was pleased to find it clean and free from further corrosion.

The operating men were so impressed that they called on Hall Laboratories again when they ran into trouble. Aluminum tanks, which they were cleaning with a strong caustic soda solution, were corroding. Hall recommended Calgonite® because it is an alkaline detergent which cleans greasy surfaces without attacking aluminum. Once again everyone was pleased when the Hall recommendation solved the problem.

Leaky Baffle Causes Foaming

A Pennsylvania chemical plant suddenly was troubled with severe foaming and carryover of boiler water. When the operators called Hall engineer J. Printz they explained that the trouble was occurring in spite of the fact that the concentrations of phosphate, sulfite, alkalinity and dissolved solids were normal.

Printz collected a sample of boiler water and noticed that it contained a greater amount of suspended solids than normal. He suspected this of causing the foaming.

Why there was so much suspended solids in the boiler water became apparent on investigation. The boiler had operated for awhile with a leak in a furnace baffle which let furnace gases short circuit to the stack without following their normal path through the furnace. This upset circulation in the boiler and permitted sludge to settle out in a section of abnormally slow circulation. The difficulty came after the baffle was repaired when normal circulation stirred up accumulated sludge.

After the boiler was drained and washed to get rid of the sludge, no more carryover occurred.

Special Silica Problem Solved

The Hall engineer was handed a real puzzle when a New England chemical plant asked him to explain why silica deposits were building up in the steam line from a 200-psig pressure boiler and on the diaphragms of the turbine which used the steam. He knew that volatilization of silica in steam does not occur at 200 psig pressure. Something unusual had to be going on. Boiler water silica concentration was normal. The deposits contained small amounts of some salts normally present in boiler water but no phosphate.

A search led to the nitrate converters. In these units water is flashed into steam. This steam at 460°C is introduced to the drum of the 200-psig boiler above the water level. There it mixes with the steam generated in the boiler and goes on to the turbine.

The feedwater to the converters was found to be high in silica. The source of the silica was finally traced to some contaminated condensate from process which was being introduced to the converter feedwater. In a case like this only the experience and training of the Hall engineer enabled him to help the operating men locate the difficulty quickly.

Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information on how the Hall System can help you solve your particular water problems, write, wire or call address below.

Water is your industry's most important raw material. Use it wisely.

HALL LABORATORIES
DIVISION OF HAGAN CHEMICALS & CONTROLS, INC.
HAGAN BUILDING, PITTSBURGH 30, PENNSYLVANIA
DIVISIONS: CALGON COMPANY; HALL LABORATORIES
IN CANADA: HAGAN CORPORATION (CANADA) LIMITED, TORONTO

Hall Laboratories—Consultants on Procurement, Treatment, Use and Disposal of Industrial Water

LOUIS N ROWLEY, EDITOR • AUGUST 1958 • ESTABLISHED 1882 **Power**

Let's kill "boiler hp"

THIS MONTH'S special report on *Packaged Boilers* brings to mind again the much-discussed subject of boiler ratings and the often-criticized but persistent term "boiler horsepower".

Straight thinking in this area begins with a clear understanding that rating is the boiler manufacturer's statement of what a given design will do, while *boiler hp* is one of several units of measurement in which capability may be expressed—not a particularly good one, in my opinion.

Before I defend that criticism, let's look a little closer at ratings. We all know that many factors influence the performance of a steam-generating unit: fuel and firing method, setting, draft conditions, to name a few. The maker of a packaged boiler controls these variables and has the further advantage of being able to shop test complete steam-generating units—either individually or as prototypes of a standard line.

The maker of a large custom-built unit normally works to definite specifications covering the various elements affecting performance. He can thus calculate overall performance with considerable accuracy and guarantee capacity under specified conditions.

In many cases, however, boiler makers face the problem of rating the capacity of the boiler proper without knowing the conditions under which it will operate. This means assuming conservative average conditions and saying that, under these conditions, each sq ft of heating surface will yield a given output.

No matter how the rating is derived, it can be expressed in several ways: in lb per hr of steam at given pressure and temperature, in equivalent direct radiation, or in boiler hp. Of these, the lb-per-hr measure is the fundamental one. Steam is the sole useful output of a steam generator; steaming capacity is what the maker sells and the customer buys. The other measures are, in effect, derived from lb per hr, and represent an effort to express steaming capacity in terms of the load the boiler is expected to supply.

There is some justification for this in the heating field. Heating-system load is often expressed as equivalent direct radiation, and boiler ratings in the same units are admittedly a convenience to architects and heating engineers.

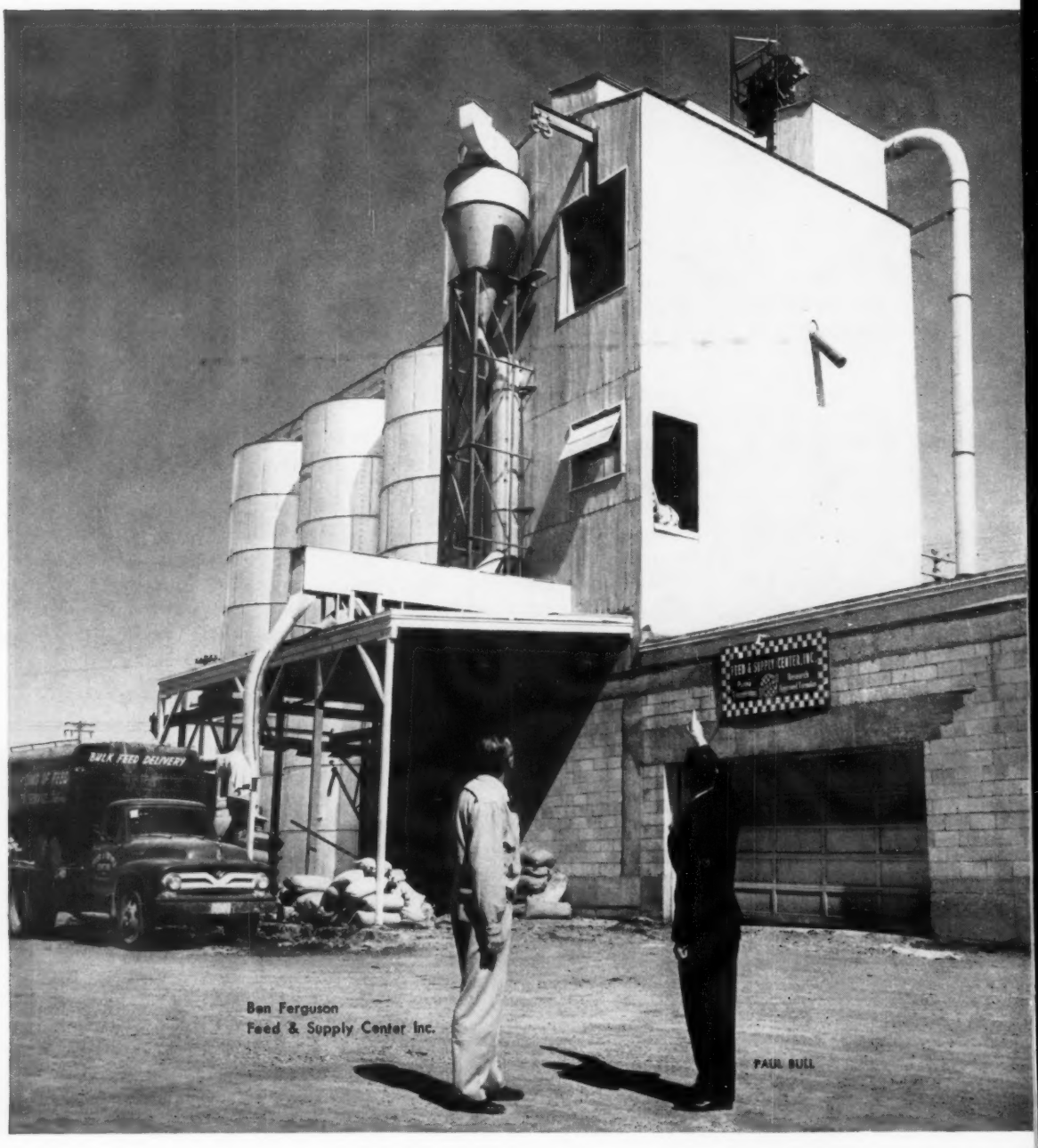
But there's no excuse except habit for use of boiler hp. Years ago, there was—a 100-hp boiler would once supply a 100-hp steam engine. Now industrial steam loads are virtually always measured in lb per hr. So the typical user slips his slide rule to get a boiler-hp figure he can match with a maker's rating in boiler hp converted in turn from the basic lb-per-hr data!

This anachronistic and unnecessary process is disappearing slowly, as lb-per-hr ratings become more common, but it could be wiped out completely by getting together on a common standard. It's clear to me that this should be the fundamental measure of steam-generator capacity—lb per hr. For the convenience of heating-system designers we could give parallel ratings in edr. But let's bury completely, once and for all, the now useless and often confusing term "boiler hp."

"A bent shaft on an elevator motor might have caused a terrible accident

. . . if Fusetron dual-element Fuses had not shut down the motor"

PAUL M. BULL, Commercial,
Industrial Representative
Idaho Power Co., Twin Falls, Idaho



Mr. Bull continues:

"As a Commercial and Industrial Representative for the Idaho Power Co., I was asked to redesign the electrical work for the Feed & Supply Center Inc., Twin Falls, Idaho. The installation was handled by Detweiler, an electrical contractor.

"When the job was completed, Fusetron fuses kept blowing on a 15 hp., motor that operates the elevator.

"Larger size Fusetron fuses were tried and the result was almost disastrous.

"When the motor started the whole elevator shaft shook as if it would tear apart. Everyone was afraid that at any second the motor and apparatus would come crashing down the shaft.

"Fortunately, the Fusetron fuses opened and stopped the motor.

"A thorough check revealed that the shaft of the motor was bent in transit.

"If Fusetron fuses had failed to open to protect the motor, there might have been a terrible accident."

You too, can benefit by the 10 point protection of Fusetron fuses.

Fusetron dual-element fuses offer the safest, most complete electrical protection possible. With rare exceptions on commercial and industrial installations — ordinary fuses and circuit breakers protect only against short-circuits — but Fusetron dual-element fuses provide 10 point protection.

Why Risk Losses! One burned out motor . . . one needless shutdown . . . one destroyed switch or panel . . . one burned out solenoid . . . may cost you far more than replacing every ordinary fuse with Fusetron dual-element fuses.

BUSS Hi-Cap Fuses—High Interrupting Capacity above 600 and up to 5000 amperes

BUSS Hi-Cap fuses offer unlimited interrupting capacity for circuits of 600 volts or less. Their high speed operation on heavy shorts limits current to safe values. This minimizes damage to equipment and cuts down dangerous stresses on transformers.

These fuses can be coordinated with Fusetron fuses to isolate fault to circuit of origin.

BUSS Limitron Fuses — Limits Fault Current to Very Low Values

BUSS Limitron fuses have extremely fast opening characteristics to prevent heavy short-circuit currents from building up under fault conditions.

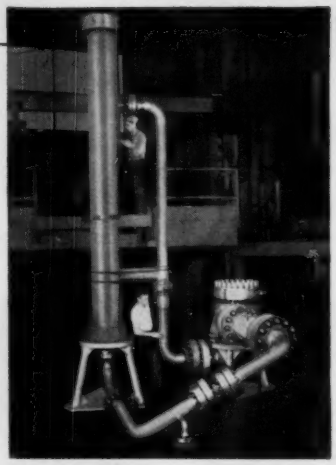
For more information write for —

Bulletin FIS *on Fusetron dual-element fuses.*
Bulletin HCS *on BUSS Hi-Cap fuses.*
Bulletin HLS *on BUSS Limitron fuses.*

Bussmann Mfg. Div.
McGraw-Edison Co.
University at Jefferson,
St. Louis 7, Mo.

Play Safe! install FUSETRON dual-element FUSES and BUSS Hi-Cap FUSES throughout entire Electrical System!

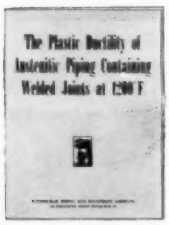
ALL IN A DAY'S WORK at *Pittsburgh Piping*



STAINLESS STEEL AUTOCLAVE and VOLUTE
Shop Fabricated

by *Pittsburgh Piping*

This autoclave and volute assembly is typical of the work that goes through Pittsburgh Piping shops. Fabricated of Type 304 Stainless Steel, it is complex in design and is built for high pressure, high temperature service. This type of fabricating is a "natural" for Pittsburgh Piping. We pioneered the application of austenitic steel piping materials for central stations operating at 1050°F. and above, and fabricated the piping for the world's first atomic-powered submarine and central station. Highly specialized methods, machines, and apparatus have been developed and are employed in this work. Use them on your high temperature, high pressure piping jobs.



WRITE FOR YOUR COPY

This bulletin reports an intensive investigation into the problem of main steam piping materials and gives data on the stress rupture characteristics of Types 316 and 347 stainless steel piping adjacent to welded joints.

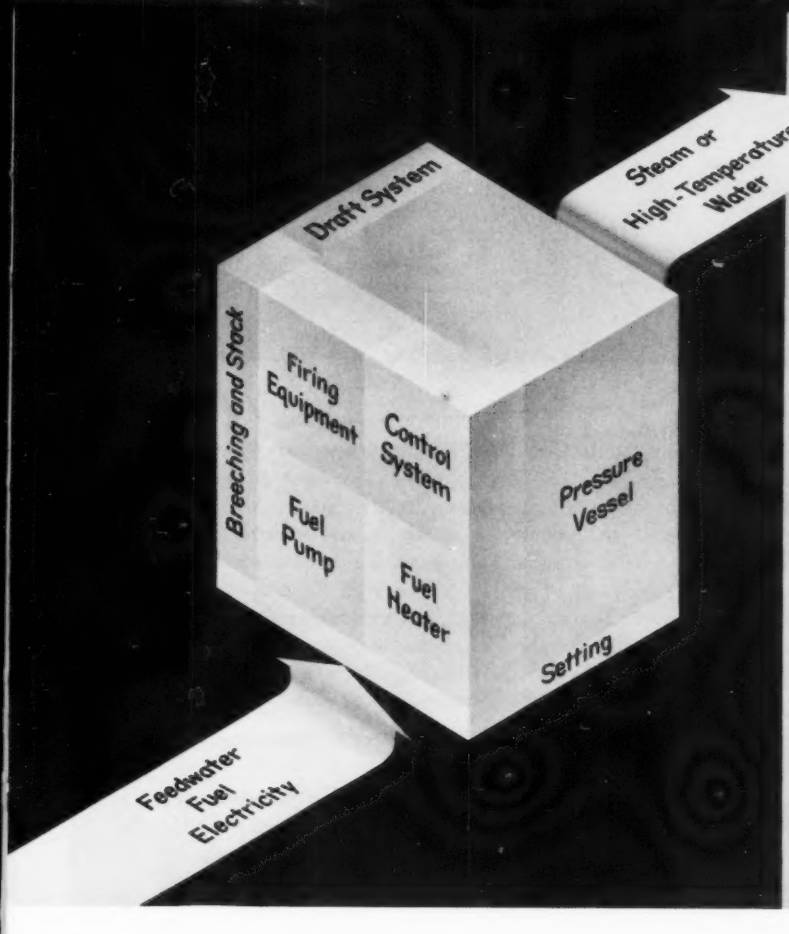
Promoting Progress ***IN POWER AND PROCESS PIPING***

Pittsburgh Piping **AND EQUIPMENT COMPANY**
158 49th Street—Pittsburgh, Pa.

Canada: **CANADIAN PITTSBURGH PIPING, LTD.,** 68 YONGE ST., TORONTO, ONTARIO

Atlanta ..... *Whitehead Building*
Chicago ..... *Peoples Gas Building*
Cleveland ..... *Public Square Building*
New Orleans ..... *P. O. Box 74*
New York ..... *Woolworth Building*

PP-32



Firetube designs	79
Watertube designs	85
Firing equipment	91
Combustion controls	95
Safety controls	96
H-t hot water	98
Maintenance	100

Packaged Boilers

By R C BELLAS, Assistant Editor

A new design concept entered the steam-generation field in the early 1930's; widening use of fuel oil for industrial purposes made it possible. Burner, draft equipment and control could be integrated with the boiler proper to make a steam-producing "package." Tremendous military and industrial demands of World War II accelerated the pace of this development. And in the postwar upsurge of industrial expansion and modernization, packaged steam generators have played a key role.

During these years, instrumentation and control development has been swift, and there have been equally rapid advances in metallurgy, fusion-welding techniques, shop fabrication and assembly procedures. As a result, boiler manufacturers have been able to offer units that are more efficient, more compact, more reliable, more serviceable and longer-lived than ever before.

A major contribution to these advances comes from the tight-knit co-operation between the maker of the boiler proper and the manufacturers who supply its fittings and appurtenances, its firing equipment, its combustion and safety controls, and, last but not least, its feedwater treatment. Tailored to the special needs of the application, the components of today's packaged boilers combine their individual excellences to produce consistently high unit efficiencies over a wide range of loads.

Add to this compact high-performance package the cost-cutting advantages of automatic operation and it's not hard to see why consulting engineers and plant management have reached quickly for steam-generating equipment that approaches the economies of large custom-tailored installations.

The American Boiler and Affiliated Industries lexicon defines a packaged steam generator as "*a boiler equipped and shipped complete with fuel-burning equipment, mechanical-draft equipment, automatic controls and accessories.*" It is to promote better understanding of these packaged steam generators that we present this report. Here you'll find what you need to know about basic designs and their characteristics, operation and maintenance. Put it to work for lower steam costs in your plant.

Why a packaged boiler?

The purchaser of a steam generator seeks many things: safe operation, efficiency, compactness and ease of control, to name several. The first of these—safety—has been increasingly easy to obtain since 1915 when the first *Code for Power Boilers* was adopted by the American Society of Mechanical Engineers. All reputable makers furnish units that meet—and often exceed—ASME *Boiler Code's* standards for design, materials, fabrication procedures and workmanship. But the *Code* did not, nor was it intended to, provide standards for other characteristics such as efficient performance.

The many elements affecting performance . . .

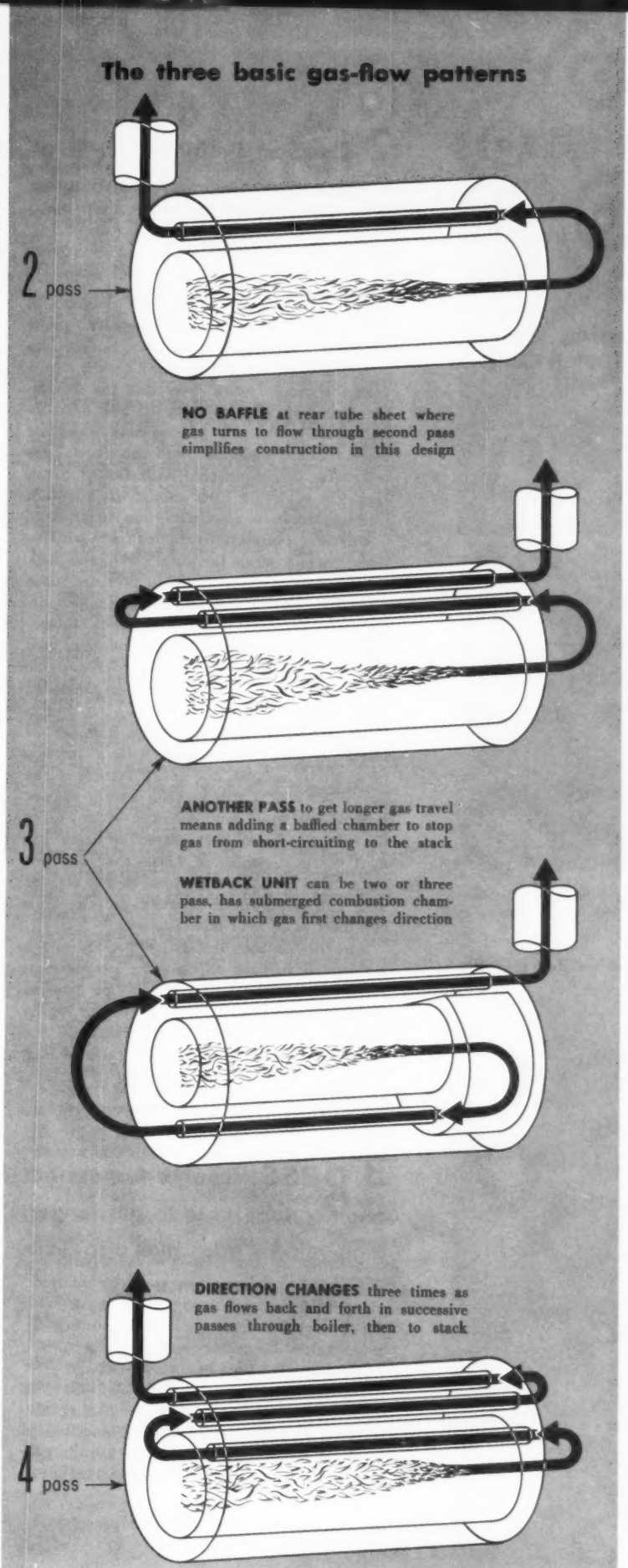
Whether the customer obtained the overall characteristics he wanted depended on the skill with which steam-generator elements—the boiler proper, furnace and firing equipment, draft system, controls and accessories—were combined. Investment in a large unit was big enough to support the cost of the engineering required to integrate the various components—usually bought from specialist manufacturers—into a harmonious whole. All too often this was not the case with smaller units, and where engineering was skimped the customer wound up with an installation that fell short of expectations.

. . . co-ordinated under one responsibility . . .

Here, then, was an opportunity. By taking overall responsibility, a manufacturer could control all the conditions affecting steam-generator performance; he could know the fuel to be used, select firing equipment and controls, determine draft conditions. Through standardization of design, he could spread the cost of skillful engineering co-ordination over many identical units. But he could go even further. He could assemble these carefully selected elements into a physically integrated unit that could be shipped as a package, ready to operate at the site after a bare minimum of connections had been made. And he could give this package a new compactness to cut down boiler-room cubage requirements.

. . . yield compact, high-efficiency units

This, then, is the basic packaged steam-generator concept. The succeeding pages show how it is currently interpreted in both firetube and watertube designs. In firetube boilers, the basic Scotch marine design, with its internally fired furnace, fitted the concept most readily. As you might expect, modern packaged firetube steam generators display visible traces of their Scotch marine parentage, but are far ahead of their predecessors in on-the-job performance. The pages that follow show these advances.


The three basic gas-flow patterns
2 pass
NO BAFFLE at rear tube sheet where gas turns to flow through second pass simplifies construction in this design
3 pass
ANOTHER PASS to get longer gas travel means adding a baffled chamber to stop gas from short-circuiting to the stack
WETBACK UNIT can be two or three pass, has submerged combustion chamber in which gas first changes direction
DIRECTION CHANGES three times as gas flows back and forth in successive passes through boiler, then to stack
4 pass

Firetube designs

They're compact and efficient, but entire steam-making process within shell limits size, pressure

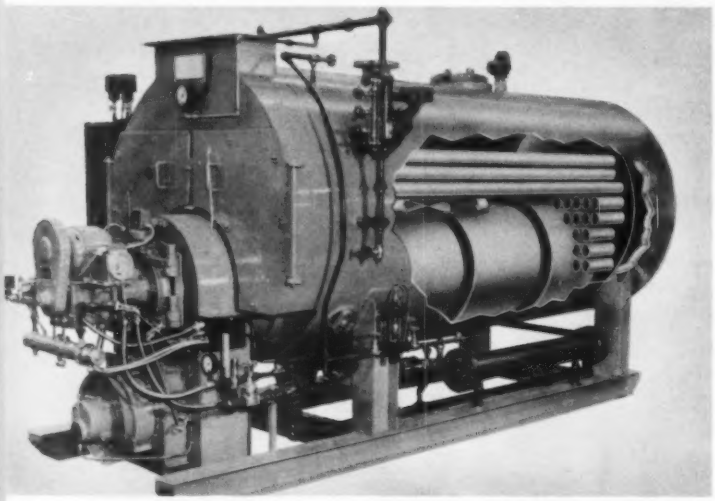
Today's packaged firetube boilers are designed around three schematic gas-flow patterns, shown at left. With a water-filled cylindrical shell housing an internally fired furnace, a relatively long gas-travel path yields high efficiency in a compact unit.

Fuels for packaged firetube units are oil, gas, or a combination of these fuels. In contrast, the parent Scotch marine boiler used solid fuels and capacity was limited chiefly by slow heat release and low gas velocity. Present mechanical-draft schemes stimulate high relative motion of fuel and air (needed for efficient combustion in the furnace tube) and step up gas velocity for high heat-transfer rates.

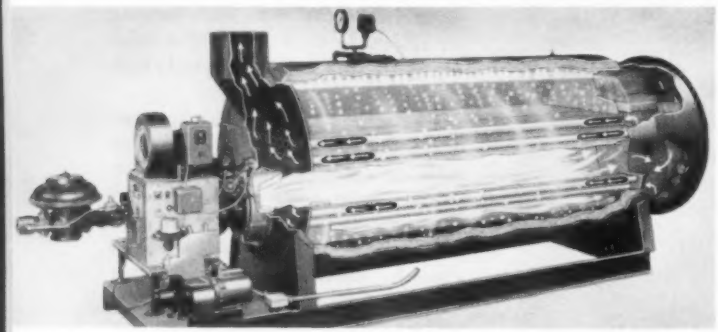
In a 2-pass design, furnace gas reverses direction at the rear head, then travels back through the tubes to the smoke outlet. In a 3-pass unit, gas reverses direction twice, at rear and front heads. The 4-pass boiler adds another gas-flow reversal.

Practical limits of size and pressure stem from the fact that entire steam-making process takes place inside a shell. Since shell strength to resist rupture is proportional to pressure times diameter, high pressures and large diameters lead to prohibitively thick shells. Maximum diameter runs about 96 in., top pressure about 600 psi. Most modern firetube units operate at or below 250 psi and below about 20,000 lb steam per hr (600 boiler hp).

Packaged firetube steam generators are rated in maximum continuous boiler hp *delivered*, terms now made realistic by shop testing of standardized designs (see box on page 82).

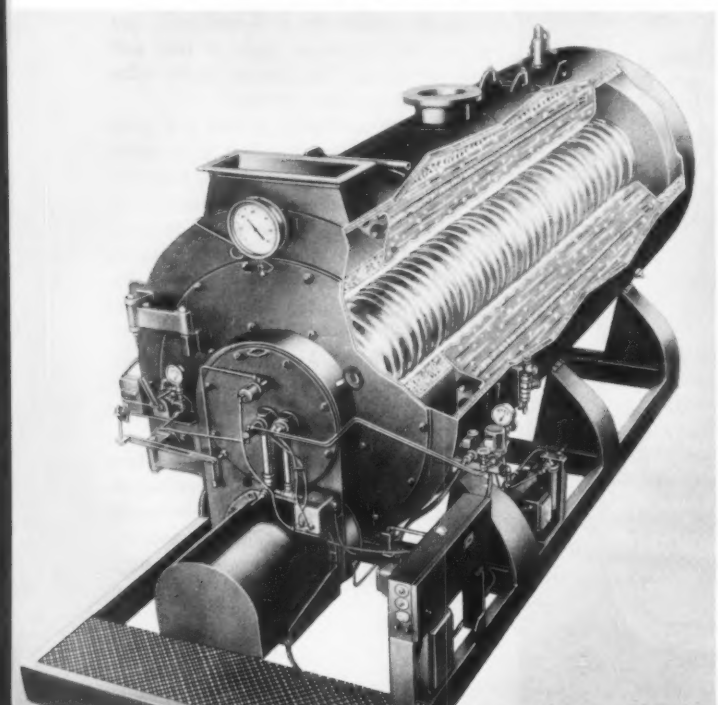


1 This unit features a ring-reinforced furnace. Tubes aligned both vertically and horizontally facilitate internal inspection and cleaning



2 Another 2-pass design having typically large furnace volume combined with relatively low water line. It takes wide load swings easily

3 With a highly turbulent flame pattern and radiant heat absorption throughout furnace length, this unit gives a high heat-transfer rate



2 pass: Designers use large furnace, proportional tube area to get high heat-transfer rates

Many arrangements are used by designers to obtain the relatively long gas-travel paths needed for efficient heat transfer. Boiler, Fig. 1, is one of several employing a simple 2-pass design without baffles. Note that the second-pass tubes are aligned vertically and horizontally. This in-line tube scheme eases waterside inspection and cleaning. Removable metal gas retarders, in conjunction with forced draft, keep gas velocities high enough to maintain intimate stream contact with tube surfaces.

Furnace construction must resist collapsing effect of *external* pressure. Unlike the shell, where stress is proportional to pressure times *diameter*, stress in the furnace tube is proportional to pressure times *area*. Thus, unsupported length is a design factor that may lead to the use of stiffening rings or corrugations. Unit, shown in Fig. 1, has a fusion-welded ring-reinforced furnace.

Combining a relatively large number of small-diameter return tubes with a furnace of generous volume is a design feature of the boiler in Fig. 2. Large furnace permits greater heat release while small-diameter return tubes provide maximum heat extraction from gas as it passes to the stack. Large shell and low water line provide increased steam storage area and large water capacity. Result: Unit can meet peak load quickly.

Another 2-pass design, Fig. 3, houses a corrugated furnace of generous proportions, completely surrounded by a single row of widely spaced return tubes. Here, the highly turbulent flame, and gas flow through the furnace and tubes produce high rates of heat transfer and high output per unit of surface.

3 pass: Smaller furnace but another tube pass to get longer, high-velocity gas travel also gives efficient performance

Adding another pass to the packaged firetube boiler means adding a baffle and increasing draft-fan power. In the simpler 2-pass design, gas-flow return is to the stack connection at front of the boiler. In a 3-pass unit, gas-flow direction is reversed at the rear head

and again at the front head. Gas then flows to the stack-outlet connection at rear of the boiler. Baffle at rear head prevents gas from emerging from the first pass and short-circuiting directly to the stack outlet. Additional fan power is needed to maintain required gas velocities through the longer travel path. But cost of adding the extra baffle, tubing and fan power may be justified by higher efficiency.

Furnace and rear combustion chamber contains almost half of the heat-transfer surface of the boiler shown in Fig. 4. Second- and third-tube passes account for remaining Btu absorption with the final pass taking the gas temperature down to a level just above the dew point.

Another variation of the 3-pass concept is illustrated in Fig. 5. Here, the designer has moved the furnace from the bottom to the center of the shell and surrounded it with second- and third-pass tubes. A one-piece refractory baffle, which can be swung in and out of position on davit hinges, serves to reverse direction of the gas flow.

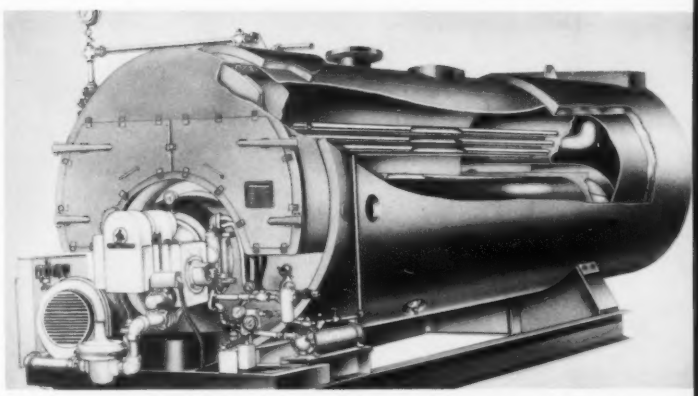
In this design, as gas travels forward through second-pass tubes, its direction is again reversed at the front tube sheet. Thus, it is forced to travel back through the second set of concentric tubes to the stack outlet at rear of the boiler. This design also has a corrugated furnace which, in addition to having needed strength by virtue of its shape, slightly increases furnace's heat-transfer surface.

Another approach to arrangement of furnace and tubes is shown in Fig. 6. Here, flue gas passes through the cylindrical combustion tube toward the rear and reverses downward, toward the front through the lower tube bank. At this point, the gas reverses again, passes through two parallel paths on either side of the furnace, then flows to a stack connection at the rear of the boiler.

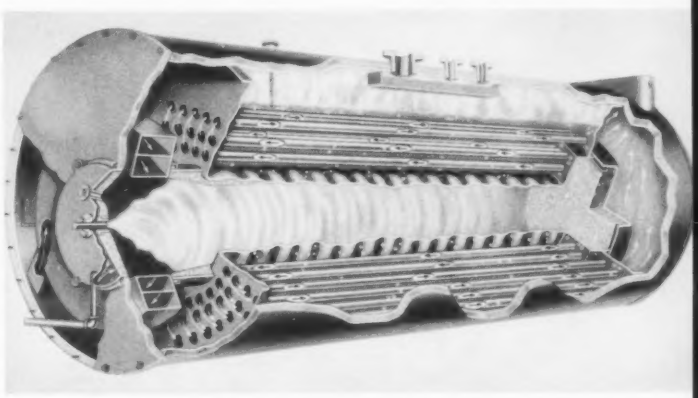
Corrugated furnace design in the 3-pass family is illustrated by Fig. 7. Designers of this boiler placed the second-pass tubes immediately around the furnace with third-pass tubes arranged in a similar fashion, but in the outer row. This particular unit does not have a staggered-tube arrangement as sometimes found in other 3-pass designs.

Tube arrangement—whether staggered or not—and furnace location—whether low or centered in the shell—point up the difference of opinion among designers in selecting the best suited heat-transfer surface setup. Each strives to wring the maximum heat energy from the combustion process through carefully designed arrangements coupled with optimum gas velocities. And, since all modern packaged firetube boilers use natural circulation, each designer arranges the heating surface to give the water-circulation path that he feels will deliver maximum steam-generating efficiency.

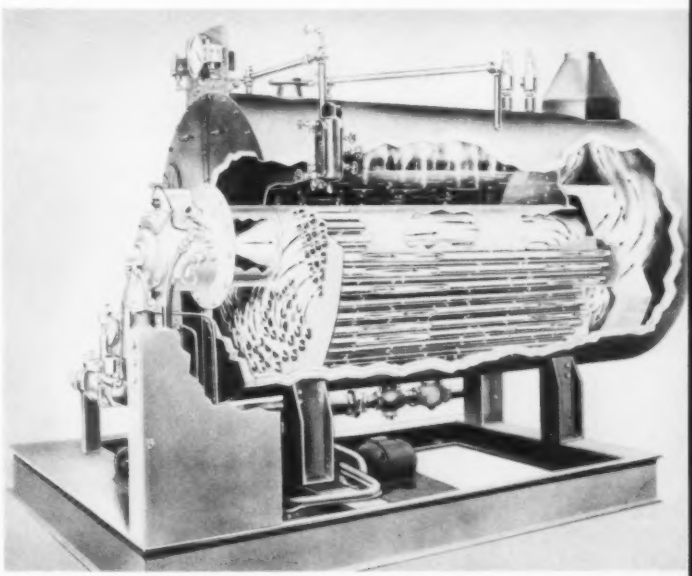
Wetback design is pictured in Fig. 8 (also



4 A representative 3-pass heating surface arrangement in which almost half of unit's total heat release occurs in the primary section



5 This 3-pass design uses a corrugated furnace and concentric rows of tubes. Front and rear flue covers swing on davits for easy inspection

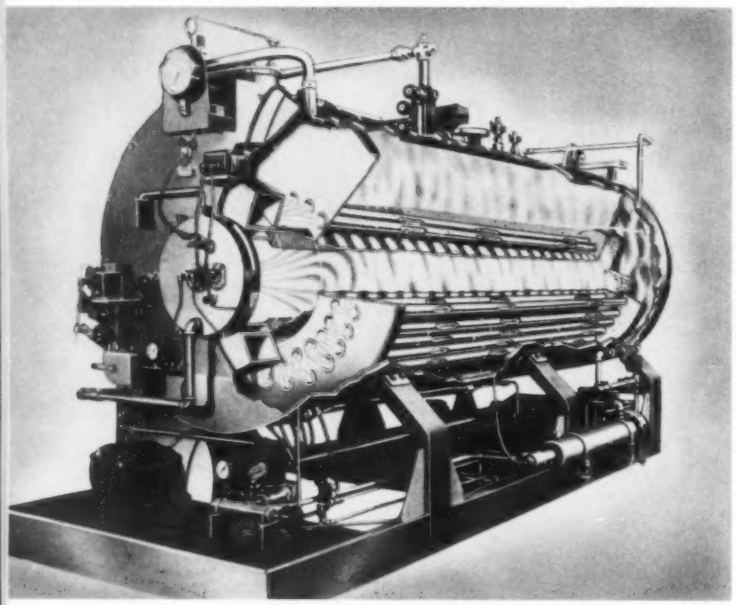


6 Another 3-pass method of achieving high fuel-to-steam efficiency; arrangement of furnace and tubes promotes uniform water circulation

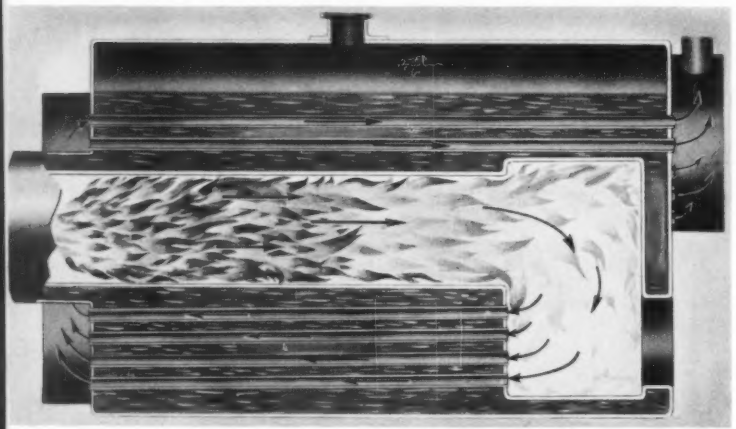
A word about capacity ratings

It was rare for the makers of firetube boilers to know what firing, setting and draft conditions their products would meet. So it became conventional to assume that, under average conditions, 10 sq ft of heating surface would produce 34.5 lb of steam per hr, from and at 212 F—equivalent to one boiler hp. Such ratings were almost invariably ultraconservative, and it was not unusual for firetube boilers to operate at 150% or 200% of "rating."

Makers of packaged units control all the capacity-affecting conditions and can shop test complete units. Hence, their rating of maximum continuous boiler hp means just that.



7 In this 3-pass arrangement, designer chose to avoid staggered tubes; puts second pass around furnace, third pass in outer tube rows



8 In the "wetback" concept, the designer provides added heating surface with submerged combustion chamber, avoids refractory at rear head

see schematic drawing on p 79). The completely submerged combustion chamber, sometimes with more than one furnace tied into it, was often used in earlier Scotch marine boiler designs. But, in today's packaged firetube units, the submerged combustion chamber is used less often and never with more than one furnace tube.

Although mentioned here as a 3-pass boiler, the wetback also is available as a 2-pass design; its chief feature is a submerged combustion chamber. Using this technique the designer adds heat-transfer surface while eliminating need for refractory material at the rear head. Note that in wetback designs, the gas-travel path is shorter through the second-pass tubes below the furnace, than through the third-pass tubes above the furnace.

4 pass: Maintains gas speed needed for high heat-transfer rate by using lesser number of tubes in successive passes

Using the 4-pass technique, the designer reaches a practical maximum in the amount of gas travel he can use. True, nothing prevents him from adding a fifth or sixth pass, but it is unlikely that such a design could be economically justified.

All boilers demand a high gas velocity for efficient heat transfer. And, as the number of gas passes increases, the fan power must be increased proportionately. Yet, merely increasing fan power isn't enough. Without increased heat release in the furnace, gas temperatures drop to an undesirable level in the fifth and successive passes. This might result in formation of harmful condensation as the gas reaches its dew-point temperature, in addition to creating a condition in which the gas would so closely approach steam-water temperature as to make further heat extraction impossible.

Heat-release rate of the furnace might be increased enough to prevent such a temperature drop, but may cause undesirable overfiring to crop up. Correct furnace proportions, particularly in the direction of flame travel, is an important factor in determining economical heat-release rates.

Danger of overfiring can be avoided by increasing size and pressure of the furnace. But, this means increasing draft-fan size, too, with a corresponding increase in power input. Thus, additional gas passes push the packaged unit to a larger-diameter shell. As already mentioned, packaged firetube boiler diameters,

beyond the conventional 96-in. limit, approach the range of economically prohibitive shell thicknesses.

Aside from design and fabrication difficulties, excessively large-diameter firetube boilers would stumble over roadblocks in meeting shipping clearances. For it is the ability to be delivered as a completely integrated unit that is one of the inviting features of the modern packaged firetube boiler.

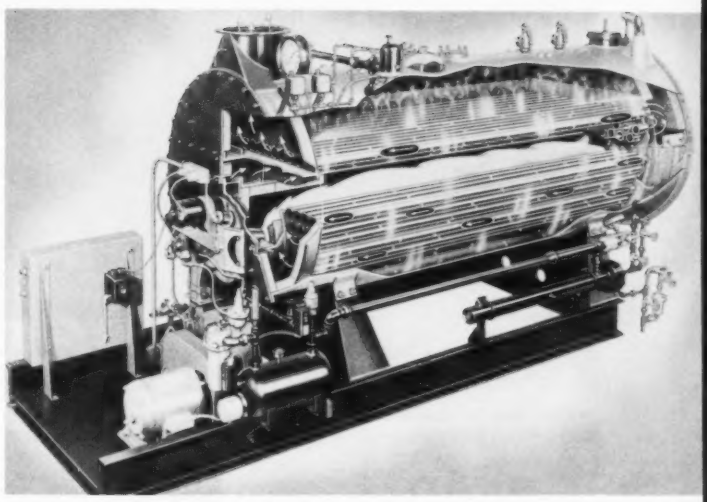
Typical design of a 4-pass unit is shown in Fig. 9. Here, the designer decreased the total cross-sectional area of each successive pass to maintain an efficiently high flue-gas velocity. Furnace pressure must be carefully calculated to prevent undesirable draft loss through the boiler and, at the same time, it must avoid excess air.

In Fig. 10, the designer approached his goal from an entirely different direction. First, he moved the carefully sized furnace to an intermediate position in the shell, but kept it far enough below the water level to give it adequate protection. Second, he arranged the three tube passes in order of decreasing number of tubes, vertically staggered, around the furnace to stimulate effective heat transfer and water circulation. After the second pass, flue-gas travel is downward through the boiler to the induced-draft fan. A plenum, interposed between the boiler outlet and induced-draft-fan inlet, helps maintain gas velocity through the four gas passes.

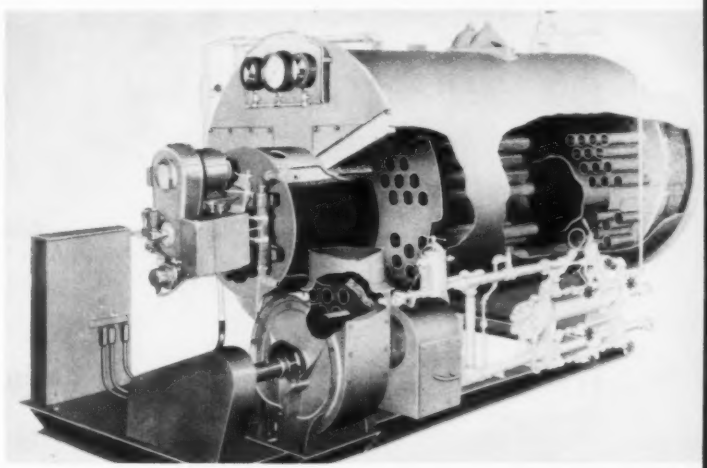
Staggered tubes and an induced-draft system are featured in the boiler illustrated in Fig. 11. As in other well-engineered packaged units, the technique of progressively decreasing the total tube area in each successive pass is adopted. Here, a relatively low-speed induced-draft fan was chosen to insure quiet operation and to sidestep the possibility of combustion products being forced into the areas adjacent to the boiler.

The packaged firetube boilers looked at in this report are broadly representative of the various design approaches followed in the search for efficient, reliable, easy-to-maintain units. Obvious limitations of space make it impossible to illustrate all designs or to discuss the individual features of each unit in complete detail.

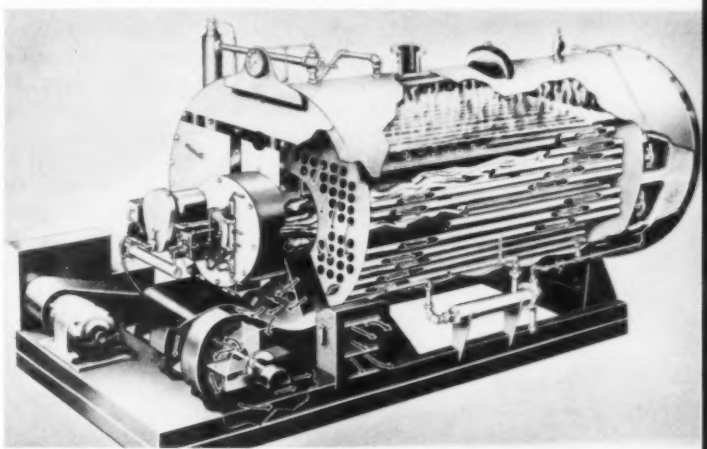
In pushing for ever-higher efficiency, the packaged firetube manufacturer is well aware of the possibility of making his designs more difficult to inspect and clean on both waterside and fireside. But, by carefully locating shell-access openings and arranging the heat-transfer surfaces with accessibility in mind, today's designers have licked many of the difficulties found in earlier packaged boilers. Units delivered today are easier to inspect and clean internally. Final shop fire-test by the manufacturer adds another user-benefit.



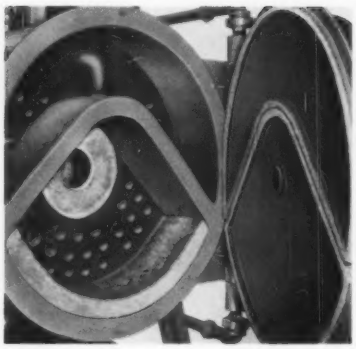
9 In this typical 4-pass design, cross section of gas-flow area (number of tubes) is reduced proportionately to maintain high gas velocity



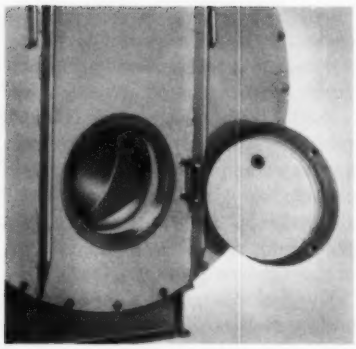
10 This 4-pass arrangement is designed specifically for firing heavy oil. It has a relatively small furnace, uses an induced-draft system



11 Another representative 4-pass down-draft arrangement that uses progressively diminishing tube area to sustain desired gas velocity

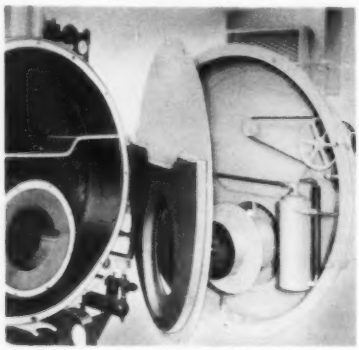


12 Water-filled rear flue cover swings open on special fittings in connecting piping. Cutaway view, *right*, shows water circulation in arch. Cover serves as an economizer

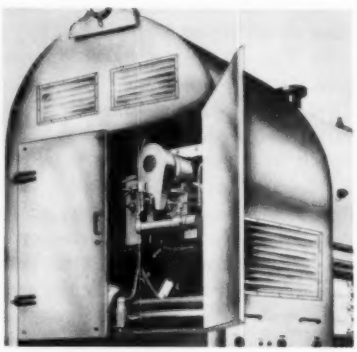


13 Refractory-lined access door in rear flue cover facilitates easy inspection

14 Davits are provided for easy handling of part or all of heavy cover plates



15 Boiler front assemblies are hinged to slash outage time, maintenance cost



16 Housing protects equipment from harmful exposure when used outside

Typical features of firetube units designed for high operational economy

To provide access for inspection and cleaning, a variety of means are employed. Fig. 12 illustrates a water-cooled V-shaped baffle that serves to control gas-flow direction and add heating surface. It is part of boiler circulation, tied to steam space with an equalizing connection. Rear head swings away from shell on piping hinges, is an independent pressure vessel acting as economizer.

Unit of Fig. 13 has a refractory-lined door for access to furnace and rear tube sheet. Another designer uses a davit for easy removal of sectioned rear cover, Fig. 14. Davit suspension appears on a number of designs, sometimes supporting the entire cover.

In Fig. 15, burner and control-panel assembly head, and front cover plate, are illustrated swung away from boiler shell. Similar "watch-case" hinging insures fast, easy access to the rear tube-sheet area.

Firetube summary. The packaged firetube unit has gained an ever-growing place in the industrial, commercial and institutional fields. Although our discussion has centered around "power" boilers, practically all packaged firetube units are available for low-pressure heating service (15 psi and below). And many of these designs can be adapted to high-temperature water systems.

Though none of today's firetube packages are available for firing solid fuels, some designers admit to more than passing interest in pulverized coal. Big question: When, if ever, will a small mill—with discharge size consist such as to almost entirely eliminate bottom ash—become available?

Oil or gas fired, the modern packaged firetube unit operates with fuel-to-steam efficiencies of about 80% over a wide load range. Though limited in capacity to about 600 hp (20,000 lb per hr), these boilers have been installed in battery by some users, in preference to a larger field-erected watertube unit. But, today, for these higher capacity ranges, packaged watertube units are available. Let's take a look at some of them.

Today, 40% of new installations under 100,000-lb-per-hr unit capacity are packaged . . .

Watertube designs

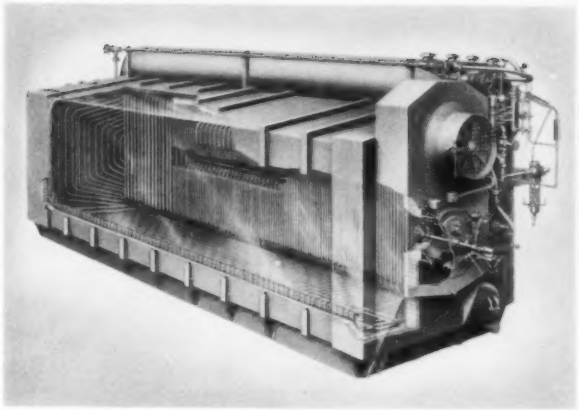
The packaged watertube steam generator appears to trace its ancestry back to the shop-assembled watertube designs introduced in the 1930's. In these early units, the boiler and its casing were completely fabricated before delivery. At the site, the unit was placed on a prepared setting and firing, draft and other equipment was added.

Rapid progress in packaged watertube design has been made in a relatively few years. Units up to about 60,000 lb per hr are now delivered ready for operation. Larger sizes are generally shipped as shop-assembled boilers, with firing and draft equipment shipped separately. These boilers require no prepared setting other than a floor of sufficient strength, and no skilled labor for assembly prior to operation.

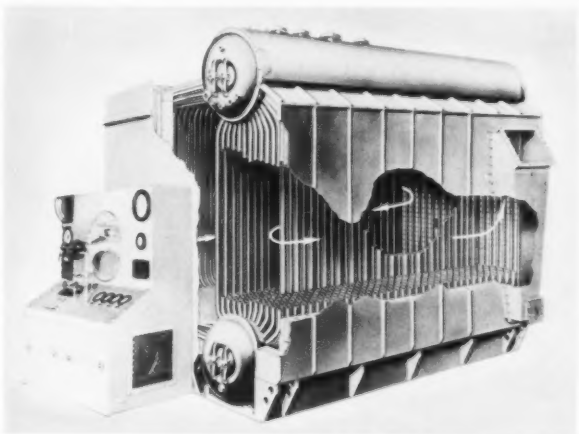
Like the firetube package, watertube units are designed principally for oil, gas or combination firing, but they present greater possibilities for adaptation to solid fuels. Some watertube packages are now operating successfully with specially designed stokers. Both boiler and firing-equipment designers, aware of the desirability of units capable of burning solid as well as liquid and gaseous fuels, are bending their efforts in this direction (see page 93).

Pressure and size limits faced by firetube designers don't exist in watertube units. With tube diameters of about 2 in., walls don't become objectionably thick even at extremely high pressures. Capacity can be increased readily by using more tubes. And the drums, which provide convenient collecting points in the steam-water circuit and for steam release, can be easily held to practical dimensions. With pressure parts such as these at his command, the packaged watertube designer finds shipping clearances his chief capacity limitation.

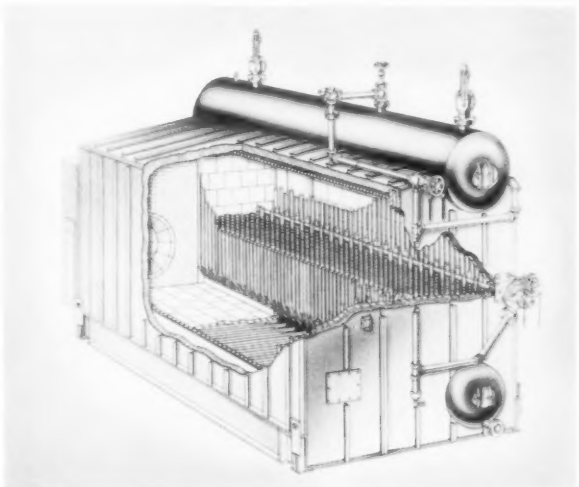
Majority of today's watertube packaged units have capacities ranging up to 60,000 lb per hr, and pressures to 900 psig. But one recent unit was designed for a maximum allowable working pressure of 1950 psig.



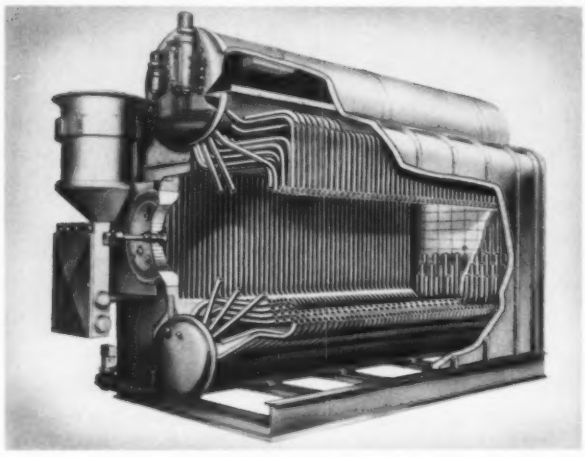
1 Watertube unit's small tubes promote high rates of heat transfer. Division wall gives long travel before gas enters the boiler bank



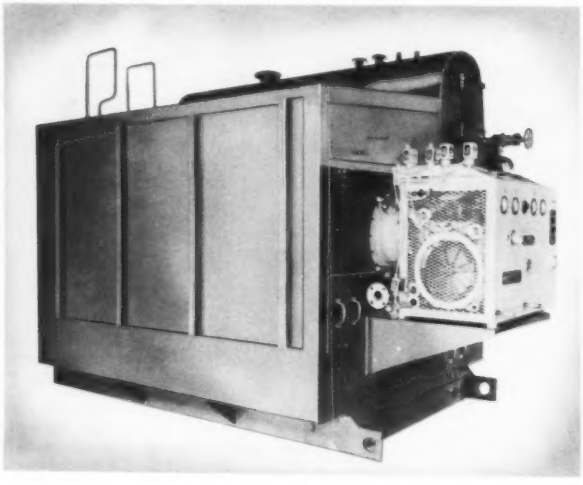
2 Water cooling on four sides, roof and floor gives high ratio of furnace cooling to furnace volume, produces rapid heat absorption



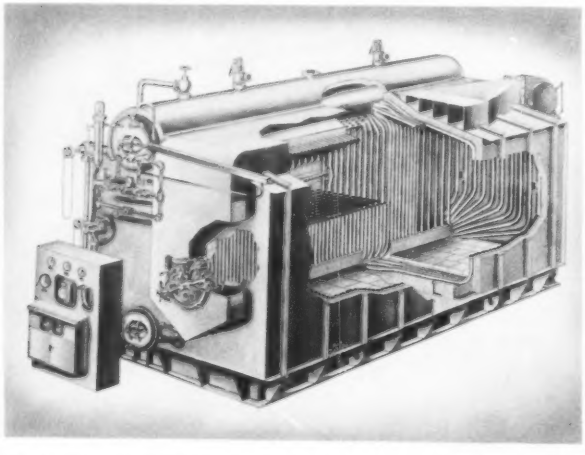
3 Closely spaced furnace-zone tubes, water-cooled rear wall are designed to give high heat absorption, low refractory maintenance



4 Water-cooled walls, with tangent tubes in both furnace and outside walls, is another method of achieving economical steam generation



5 Example of well-designed steam-generating assembly in compact casing, complete with burner and controls, ready for installation



6 Centrifugal forced-draft fan mounted at rear of boiler provides air-cooled furnace roof. Air duct can house steam type air heater

Another unit, operating at lower pressure, has a capacity of 100,000 lb per hr.

Since pressure parts exposed to radiant heat have small diameters and contain only a limited amount of water at any given time, effects of possible failure are highly localized. Thus, the watertube designer enjoys considerable freedom in disposing heating surface and has some latitude in adjusting furnace design to suit fuel and firing method. With unit's maximum cross section fixed by shipping clearances, necessary furnace and boiler heating surface is usually gained by increasing length while holding cross section constant. Burner flame shape is designed to prevent impingement on furnace walls and to fit desired furnace length. Balancing the various factors, the designer comes up with a furnace having desired volume and cooling surface. This permissible flexibility in layout produces some degree of design variety. Fig. 1 through 19 show representative packaged watertube steam generators.

Waterwalls handle the bulk of the heat absorption in most packaged watertube units. Exposed to radiant heat, waterwall heat-transfer rate is high, so a given tube area does a big job. In nearly all designs, drum is arranged with long axis parallel to furnace length. All combine waterwall and convection surface and are, in general, well-suited for low-head applications.

All firetube packaged boilers are characterized by circulation produced by thermal difference—*natural circulation*. As we'll see further on in this report, some watertube designs have circulation produced by a pump. This *forced circulation* is designed for steam generation and for high-temperature-water applications (see page 98).

In Fig. 1, small tubes promote high rates of heat transfer. Designer uses a division wall to get long travel and thorough mixing of combustion products before they enter the boiler bank. Fig. 2 shows another compact, highly efficient unit. Water cooling on four sides, roof and floor gives a high ratio of furnace cooling to furnace volume, plus rapid heat absorption. Arrows show path of gas travel in two passes through the convection bank.

Gas passes in watertube units are defined differently than in firetube. Despite some differences of opinion among designers as to accuracy of the terminology, the furnace tube in a firetube packaged boiler is commonly referred to as the first pass. Hence, a firetube boiler with a furnace tube and two successive gas passes is termed a 3-pass boiler, and a unit with a furnace and three successive gas passes is termed a 4-pass boiler. In the packaged watertube field, however, the furnace or combustion chamber, with its radiant

surface, is never referred to as a boiler pass. The gas passes are areas where combustion does not normally occur, and where heat transfer is by convection. The unit in Fig. 2 is thus correctly referred to as a 2-pass boiler.

Designer of the unit in Fig. 3 also chose closely spaced tubes in furnace zones, for maximum heat absorption and minimum refractory maintenance. Water-cooled rear wall gives added heating surface and refractory protection. In this boiler, as in other packaged watertube designs, height and width are standard for all sizes; length varies with capacity. Overall dimensions are sized to fit standard railroad flatcars.

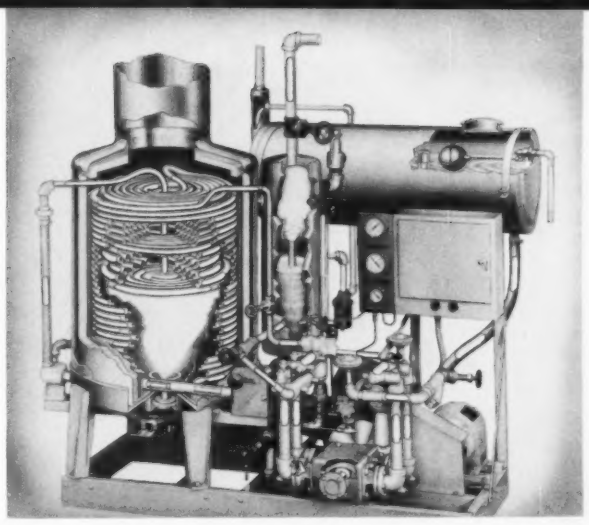
In Fig. 4, the designer selected completely water-cooled walls with tangent tubes in both the furnace and outside walls to produce a unit capable of generating low-cost steam in a wide range of capacities. The convection-zone tubes of this 2-pass unit are closely spaced to eliminate need for refractory or steel-plate baffles. Similar high-performance heating surface is embodied in the unit of Fig. 5, shown complete with burner and controls, ready for easy, economical installation.

Air-cooled roof for furnace of Fig. 6 is provided by mounting a centrifugal forced-draft fan at rear of boiler. If desired, a steam type air heater may be installed in an air duct running the length of the boiler roof. Designer used a furnace and convection-bank arrangement generally similar to others shown, but preferred a directional baffle to a diffusion type.

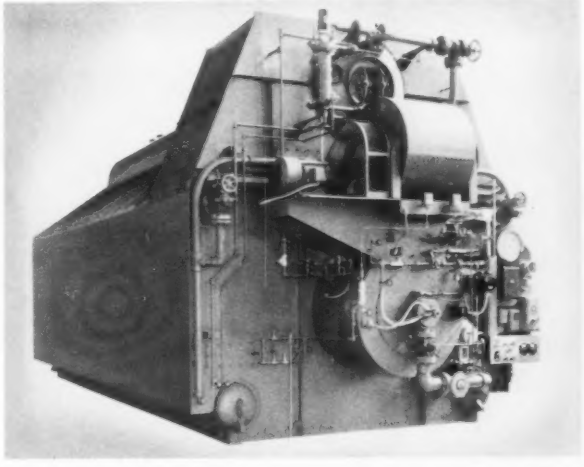
Also shown as delivered, unit of Fig. 8 is of so-called A-type construction. From the central long drum, two tube banks slant downward to headers at either side, forming a furnace with a roughly triangular section. Each tube bank has both risers and downcomers and, in effect, forms a separate steam generator. Designer protects the steam drum from excessive furnace heat by having tubes enter the drum over its entire lower surface.

Forced circulation is a feature of the units shown in both Fig. 7 and 9. Advantages offered by forced circulation include: (1) Positive circulation is assured even at extremely high pressures and under unfavorable hydraulic conditions. (2) Considerable freedom is possible in locating and arranging the heating surface. (3) Tubes may be of small diameter. (4) Ability to operate at high steam-water velocities yields high heat-transfer rates.

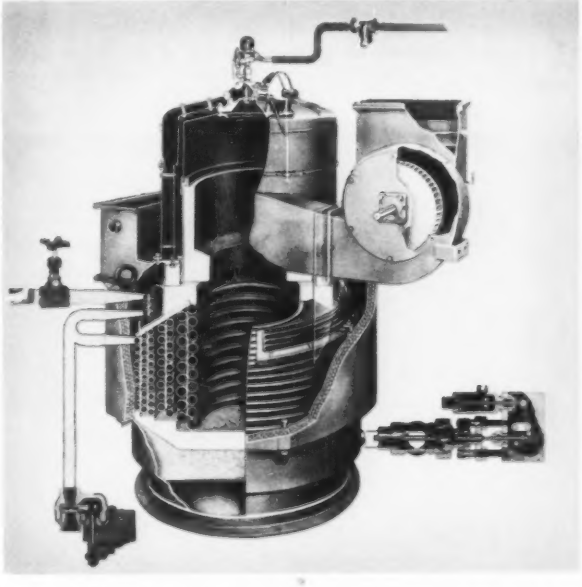
These factors add up to high specific output: more steam per sq ft of surface and per cu ft of volume. This must be weighed against the cost of circulating-pump operation and, possibly, greater fabrication complication. Widely used in Europe, where lesser material requirement per lb of steam out-



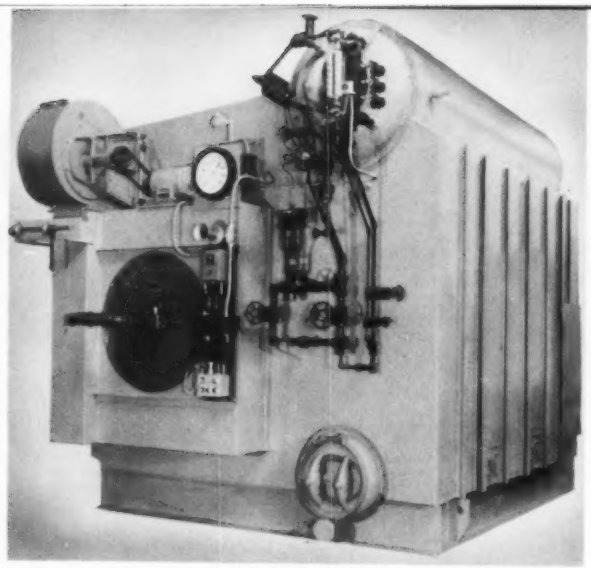
7 Generally for use in smaller-capacity applications, coiled-tubing forced-circulation units can raise steam fast from a cold start



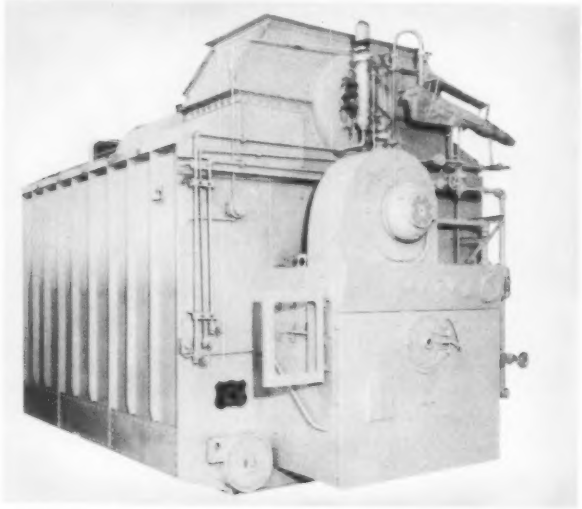
8 Shown as delivered, unit has central long drum, two individual tube banks. Fired between, each bank performs as separate boiler



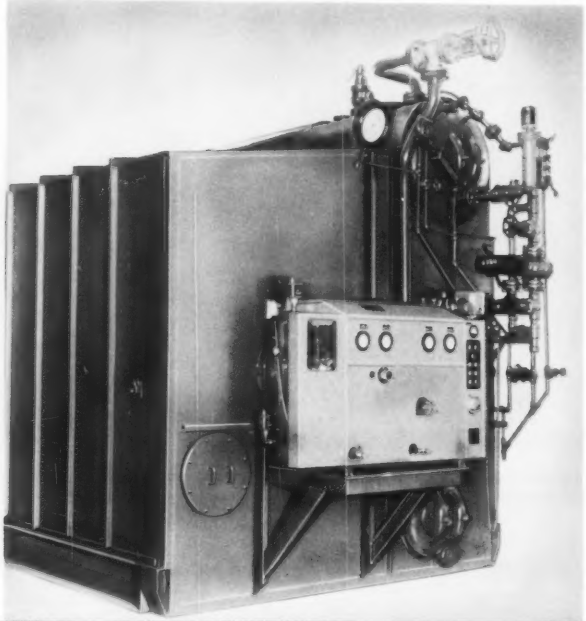
9 Another coiled-tubing unit in the lower-capacity bracket (about 6000-lb-per-hr maximum) has fuel injected downward into furnace



10 For pressurized firing (forced draft only), units such as this have welded, gastight steel casing which includes the steam drum



11 Designed primarily for pressurized firing of gas, oil or both, units such as this are readily adaptable to stoker conversion



put was particularly attractive, the forced-circulation concept has been gaining steadily in popularity in the United States.

Both of the forced-circulation designs illustrated on the preceding page have the heating surface in the form of a continuous-coiled tube. Generally suited for smaller applications, these units have demonstrated ability to reach maximum pressure quickly from a cold start. In the unit shown as Fig. 9, circulation is from outside to inside tube coils to maintain maximum temperature differential for high rates of heat transfer.

LaMont type of forced-circulation design is shown shop-assembled in Fig. 13. Unlike the continuous-coil designs, LaMont units have a heating surface made up of a number of parallel small-tube circuits. Feedwater flows into a drum and steam is released there in conventional fashion. A circulating pump takes suction from drum bottom and discharges to tubes forming the heating surface. Orifices in the tubes control flow in accordance with the heat-absorption rate, thus allowing drum and heating-surface arrangement to conform to space requirements essentially without hydraulic limitations.

The LaMont type has proved well-suited to steam, high-temperature water and thermal-liquid applications. Fig. 13 shows a LaMont thermal-liquid heater, while Fig. 14 shows a typical controlled-circulation unit designed specifically for steam generation.

In thermal-liquid applications, any one of a number of suitable fluids is heated to a relatively high temperature, say 600 F, while pressure is maintained at or slightly above atmospheric. A circulating pump takes suction from the heater and discharges through a piping system to heat exchangers at points where process or space heat is needed.

Thermal-liquid designs are being given increased attention by boiler manufacturers, some of whom have been producing them for about 20 years. One unit, under development at the moment, employs a combination fired liquid heater and water-filled heat exchanger in which steam is generated. Both the thermal liquid and the steam can be used as desired for process and space heating.

Returning to natural-circulation designs, Fig. 10, 11 and 12 show further examples of completely integrated packaged watertube units, and a variety of external forms. All three designers chose a long-drum construction; units of both Fig. 10 and 12 have the convection banks located at one side of the furnace, while the unit in Fig. 11 employs

← **12** This typical unit's compact dimensions reflect designer's tailoring to meet shipping clearances

divided tube banks with individual headers.

Fig. 15 is another representative design incorporating tangential tubes for the furnace floor, sidewalls, baffle wall and roof. It has a water-cooled rear wall and the main-bank tubes are staggered to achieve a high heat-transfer rate.

Soot blowing represents a point of difference between packaged firetube and packaged watertube units. The firetube design doesn't readily lend itself to installation of soot-blowing equipment. With relatively large tube diameters, as compared with watertube boilers, and with the products of combustion confined within the tubes, the turbulent, high-speed gas tends to produce a scrubbing action and maintain tube surfaces relatively free of combustion deposits. The fireside surfaces of the tubes may require brushing at periodic intervals; the length of the intervals depending on the cleanliness of the combustion process and the type of fuel used (see page 100).

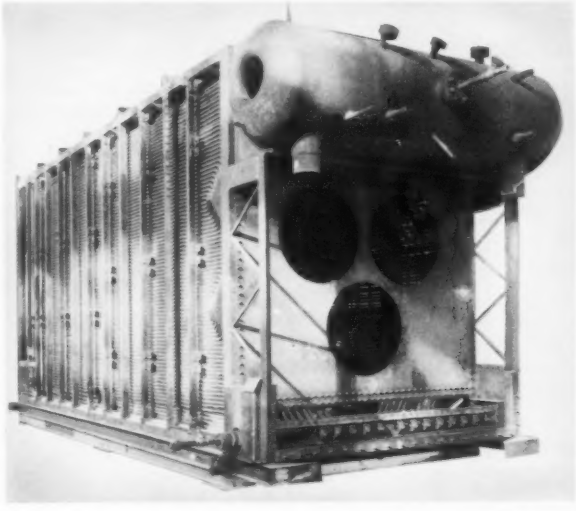
Practically all watertube packaged boilers are equipped with soot blowers when delivered, or have provision for easy installation of soot-blowing elements. Cleaning action of the soot blowers, usually of the steam type, is identical with that of rotating-element types used in all watertube boilers, as far as operating procedure is concerned.

Superheaters are, to all practical purposes, not encountered in packaged firetube boilers. In their capacity range, the user is rare who has a need for superheated steam. There are some superheater installations in packaged firetube boilers, but these are exceptional cases.

In the packaged watertube field, however, need for superheat is not uncommon and practically all large-capacity watertube packaged boilers have superheaters or space provision for future installation.

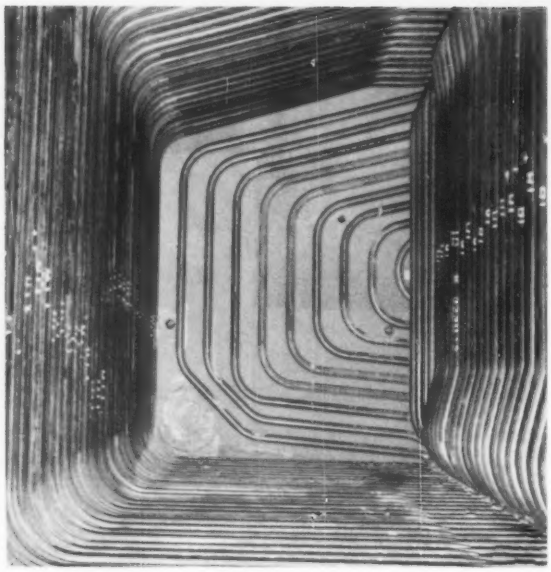
Both Fig. 18 and 19, next page, show typical examples of superheater installation. Though furnace configuration is quite similar in both cases, solutions are different. Designer of the unit in Fig. 18 locates the superheater inlet and outlet headers near the bottom drum. This positioning of the outlet header makes the superheater drainable. The designer of the unit in Fig. 19 locates his superheater in approximately the same position as the designer of Fig. 18. But, preferring to keep piping runs to and from the superheater as short as possible, he mounts the inlet and outlet headers near the top drum. This superheater is a nondrainable type.

13 LaMont type forced-circulation designs are used for steam generation, high-temperature water and, *above*, thermal liquid heating

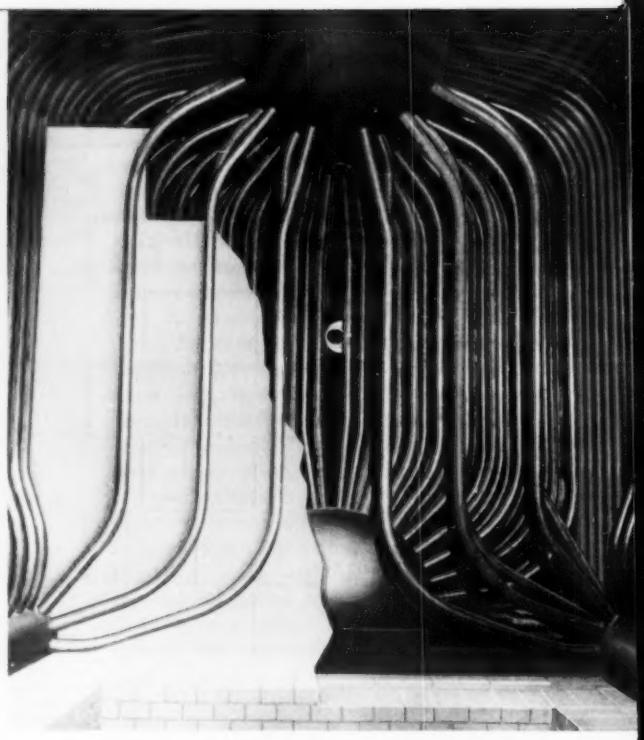


14 Controlled-circulation steam generator has heating surface comprised of multiple, parallel small-tube circuits from and to drum

15 Another typical unit which uses tangential tubes in furnace floor, sidewalls, baffle wall and roof →



16 Closeup shows typical tangent tube construction for furnace roof, sides, floor. Waterwall also protects rear refractory



17 This furnace design also uses central long drum and closely spaced waterwall tubes. Note soot blower in convection bank

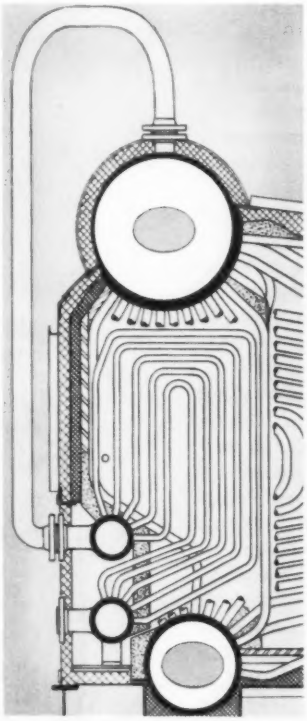
On preceding pages, attention has concentrated on the general arrangement of heating surface, and the illustrations have shown complete units. The photographs above give a closeup view of heating surface in two packaged watertube units. Fig. 16 illustrates the type of rear-wall construction often used in the furnaces of these units.

Fig. 17 shows the tile refractory baffle between the radiant and convection zones. The small circle visible in the center of the convection tube bank is the forward end of a soot-blower element.

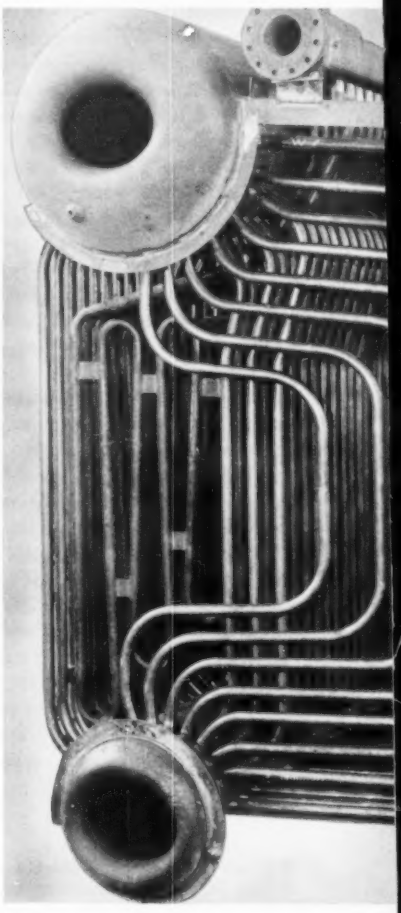
Watertube summary. Picking up in capacity near the upper end of the firetube range, the watertube packaged steam generator extends the availability of the packaged concept to beyond 60,000 lb per hr, and to pressures even higher than 900 psi. With maximum cross section fixed by shipping clearances, length can be varied to up capacity, but this may restrict delivery to some areas.

Using small-diameter tubes, designers display considerable ingenuity in devising compact and efficient heating-surface layouts, with heavy emphasis on waterwalls. While most units still depend on natural circulation, forced-circulation designs are gaining popularity, particularly as high-temperature-water and thermal-liquid heaters.

Having concentrated thus far on the heat-absorbing part of the unit, let's turn now to the heat-release area and look at some of the overall characteristics of the firing equipment integrated with firetube and watertube units.



18 Drainable superheater fits easily into the basic boiler design



19 This nondrainable superheater has outlet header atop boiler

Firing equipment

Generally, no fuel will ignite and burn unless, or until, it's in gaseous form: This is a fundamental fact of combustion. To support combustion, enough oxygen must be present. But, even if there is a sufficient volume of oxygen, efficient combustion cannot be maintained unless each minute particle of combustible substance, in gaseous form, is supplied with its own adequate share of oxygen (see special report *Fuels and Firing*, POWER, Dec 1948).

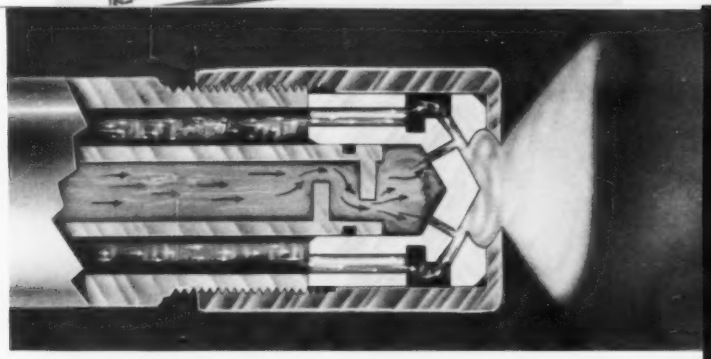
Fuel-oxygen mix, to be successful, must result from producing high relative motion in eddy-current fashion. This is commonly called turbulence. We don't get the combustible mixture we're after if fuel-oxygen velocity is simply high but of a laminar nature.

Now, if we have a combustible gas, plus the exact amount of air to burn it completely, and the two are correctly mixed, we still need another element—heat—for proper combustion reaction. The mixture cannot be below its ignition temperature for initial lightoff. The fuel-air mixture is brought to this point by heat from an outside source until instantaneous combustion occurs.

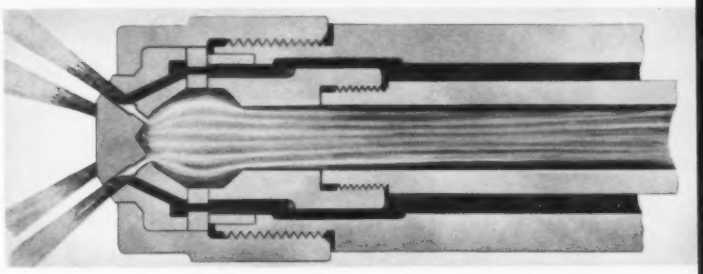
From this point on, if heat is generated by the reaction faster than it is lost to the surroundings, combustion becomes self-sustaining. Below this point, the fuel-air mixture won't burn freely and continuously unless sufficient heat is added from an outside source.

Although we supply all conditions necessary to produce and sustain efficient combustion, we haven't achieved our goal until we convert the released heat energy into a more useful form. Here's where the boiler comes into play. Heat absorbed in its furnace and gas passes converts water into useful steam.

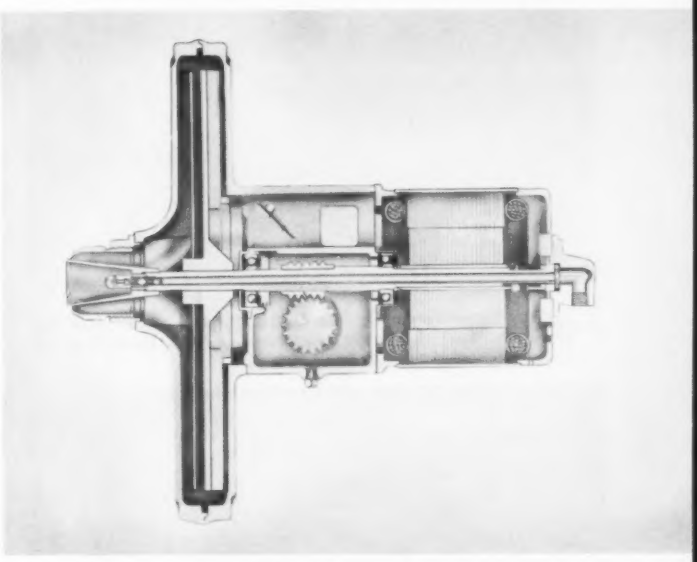
Furnace design is most important in providing the physical conditions necessary for combustion. Here, the fuel is vaporized or distilled, mixed with air, ignited, and the resulting fuel-oxygen reaction carried to a finish. If the furnace isn't big enough, or isn't hot enough, the combustion process cannot be carried to completion. And combustion must be completed between the boiler and the furnace outlet, in an extremely short time. In the combustion process, time is closely related to distance. So packaged-boiler furnace designers carefully calculate furnace lengths to insure complete combustion. Briefly: Successful combustion depends on the three *T*'s—*Time*, *Temperature* and *Turbulence*.



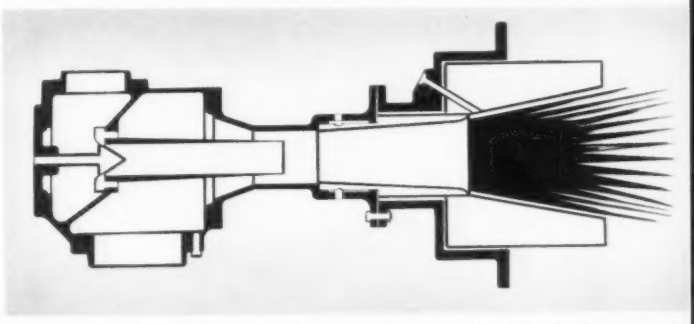
1 In typical air-atomizing nozzle, fuel flows through central tube and is picked up at multiple injection points by individual air streams



2 Steam-atomizing nozzle has somewhat similar action. Steam jet hits oil stream at acute angle, produces highly turbulent mixing action

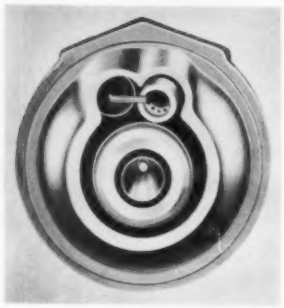


3 In rotary-cup atomization, built-in fan turning at motor speed supplies primary air which catches up fine oil spray leaving cup edge

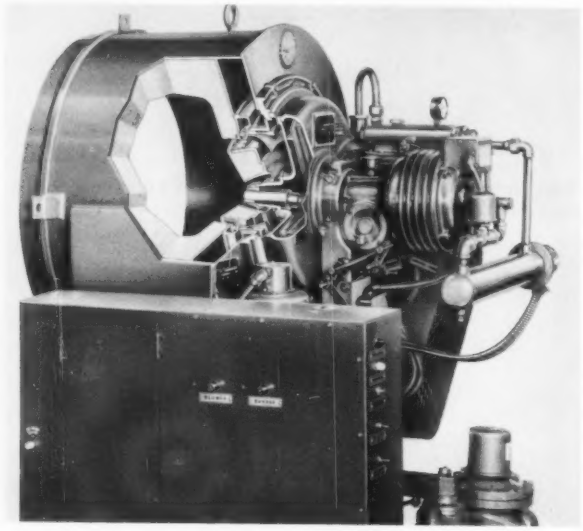


4 Gas firing is relatively easy since fuel as supplied is ready for combustion. However, burner must prepare right mixture of gas, air

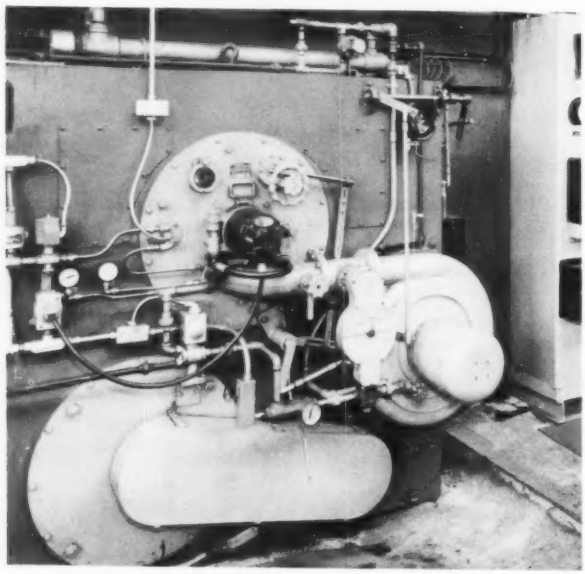
5 Most burner designs permit automatic changeover to gas, oil



6 Closeup shows an arrangement for electric-gas pilot ignition



7 Typical burner design for forced-draft firing of gas or light and heavy oils. Fuel changeover is accomplished by throwing switch



8 Integrated burner units such as this are representative of the close co-operation between boiler, firing equipment manufacturers

Some manufacturers of packaged boilers develop and furnish their own firing equipment. Others utilize units specifically designed for the packaged boiler field by oil burner manufacturers. Remember: These latter units are not designed in isolation, but are the result of close co-operation between boiler designer, burner designer, combustion and safety control engineers.

Complete integration is the dominating theme in today's packaged boiler firing equipment, whether or not the latter is the specific product of the boiler manufacturer. In most instances, particularly with packaged firetube designs, the burner must meet performance standards in carefully controlled firing tests before the boiler unit is delivered to the user.

Oil-firing equipment serves the furnace with a suitable fuel-air mixture. This means raising oil's temperature to prepare it for quick conversion from liquid to gaseous hydrocarbons. Light-oil-burning boilers have electric heaters for cold startup and maintaining right oil temperature. For heavy oil, steam-type heaters take over after startup, provide proper viscosity at burner nozzle. Fig. 1, 2 and 3 show some typical nozzle designs.

If oil is to be vaporized in the combustion space, it requires literally breaking the whole into many small particles. In this way, the maximum surface is exposed to heat. Termed *atomization*, the breakup is accomplished by one of three methods: (1) using steam or air under pressure to break the oil into droplets (2) forcing oil under pressure through a nozzle or (3) tearing an oil film into a mist by centrifugal force. Note, in Fig. 1 and 2, the designers use air and steam pressure, respectively to produce oil atomization.

Gas burning is relatively simple since fuel as supplied is ready for combustion. Gas-firing equipment proportions and mixes gas and air. Fig. 4 shows a representative gas-burner design.

Practically all firetube and watertube packaged boilers can be equipped with gas, oil, or combination burners. With the latter, a change to either fuel may be accomplished either automatically or by manual switching.

For gas burning, an electric spark or gas pilot provides ignition. With oil, an electric spark ignites a gas pilot which, in turn, touches off the oil. In either case, safety controls stand by during lightoff to shut down the unit should ignition or flame fail.

Combination gas-oil burner, Fig. 5, has a rotary cup for oil firing and a circular row of nozzles set in a manifold ring for gas operation. The design shown in Fig. 6 is another combination unit.

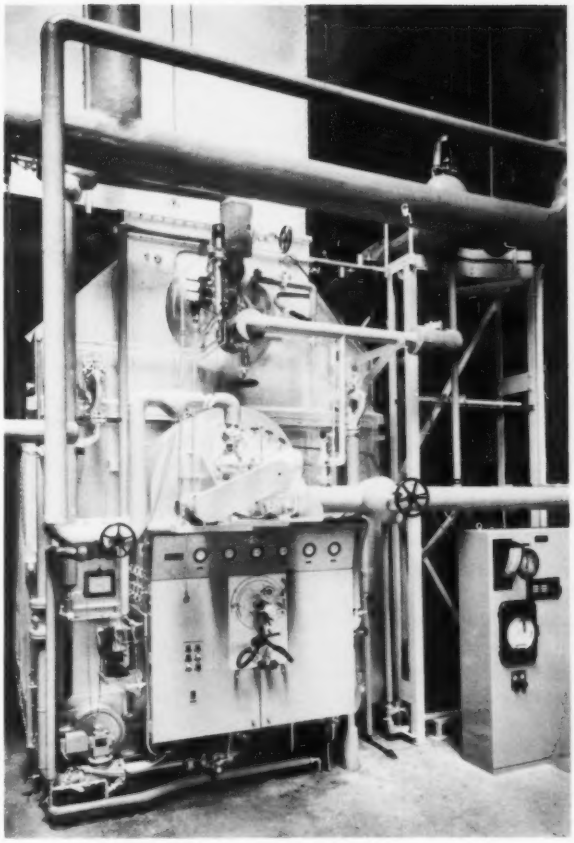
One boiler manufacturer's design, shown in Fig. 7, has a direct-drive, horizontal rotary type burner mounted on the front plate of the boiler windbox along with all necessary con-

trols and accessories. In this unit ignition is handled by either a gas-electric or a light oil-electric pilot system. It is a combination gas-oil burner which does not require removal of the gas burner when operating with oil, or vice versa.

Other combination gas-oil burners that are integrated with packaged boilers are shown in Fig. 8 and 9. Neat, compact and efficient, they are typical of the many completely self-contained combustion units available today to the packaged boiler user.

Those boiler manufacturers who design their own firing equipment would, of course, prefer to deliver packaged units to the user complete with their firing equipment. And, in the interest of standardization, the boiler manufacturer who does not make his own burner selects firing equipment well suited to the overall package. However, should a customer prefer a firing unit other than that usually supplied, such equipment can generally be made available, though the boiler manufacturer would be unlikely to assume responsibility for its performance.

Inherent simplicity of storing and handling fluid fuels has been one of the factors that has spurred industry's acceptance of firetube and packaged watertube boilers. All of the present packaged firetube units were designed specifically to burn oil or gas. This stems directly from the simplicity and compactness of the fluid burners compared with solid-fuel firing equipment, which isn't easily adapted to internally fired designs.

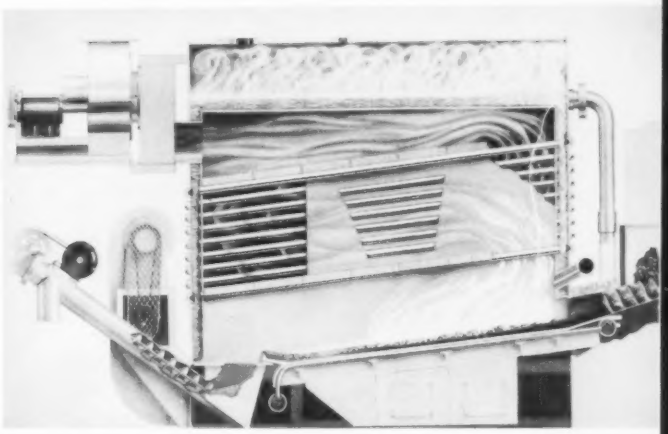


9 Compact, highly efficient unit shown is typical of self-contained combustion equipment available to packaged boiler users

Solid-fuel firing shows promise

Absence of solid ash refuse in the furnace, plus ease and flexibility of controlling ignition and burning rates for gas and oil, have added to their widespread use. Another consideration is the high mass gas-flow velocities that can be employed with liquid or gas fuels. Furnace heat release rates may, with complete safety, be greater than those for solid fuels. This holds true providing furnace design includes a minimum of refractory and a maximum of radiant heat absorbing surface. In brief, it is these factors in firing fluid fuels that influenced designers to develop compact units with their high steam-generating rate per sq ft of boiler surface.

Today, however, there is an increasing demand by both government agencies and private industry for coal-fired packaged boilers. Naturally, coal producers are spurring de-



10 With automatic firing, ash handling, unit shown is one result of industry's demand for solid-fuel-fired packaged steam generator

velopment of such units. Too, makers of solid-fuel firing equipment are keenly aware of the market potential for their products in this field.

Last five years has been a period of concentrated effort to promote development of a truly packaged coal-burning boiler. Problems inherent in making the coal unit competitive with oil or gas firing are being met by energetic co-operation of interested parties.

While it is recognized that a somewhat higher initial investment may be required for a coal-fired unit than one for gas and oil, other factors would tend to have a balancing influence on a long-term basis. Typical: In many areas, coal offers the possibility of lower cost per Btu delivered to the plant, reasonably certain long-term availability of fuel and less likely interruption of supply in the event of a national emergency.

Storage and handling problems assume greater proportions with the solid fuels. They are essentially nonexistent with gas and are more readily handled in oil firing. Today, the coal-fired boiler and firing equipment designers are striving to more closely approach the cleanliness, convenience and automatic features inherent in fluid-firing equipment.

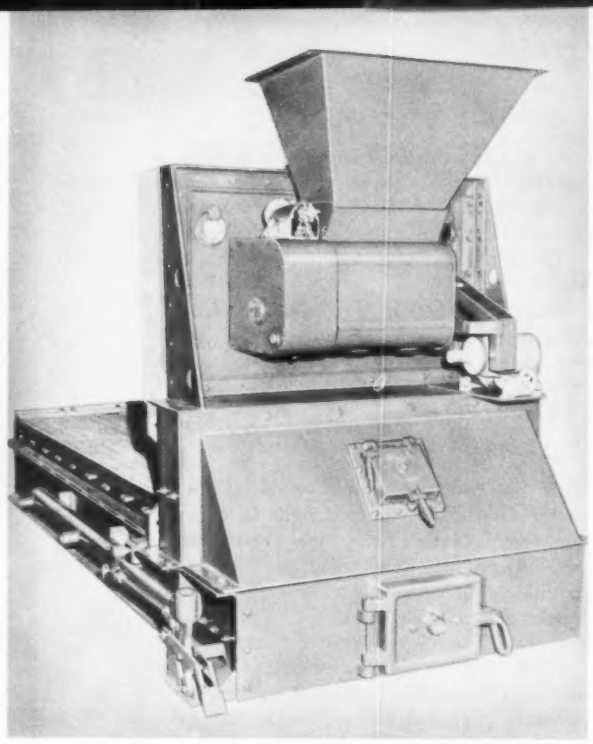
Co-operative research by boiler manufacturers, firing equipment makers, and the bituminous coal industry led to the design shown in Fig. 10, page 93. This unit features a straight-tube watertube design having a water-cooled vibrating grate, automatic fuel feed and ash removal. A simple control system guides automatic startup, automatic operation through the load range and automatic maintenance of a banked fire.

Oscillating grate, developed for watertube packaged boilers, is illustrated in Fig. 11. Here, a hopper feeds a horizontal grate which, through carefully controlled pulsations, gives unidirectional flow to the fuel bed. Smaller grate sizes that are limited by shipping requirements can, if desired, be assembled in their boilers and shop tested before being shipped to the customer's site.

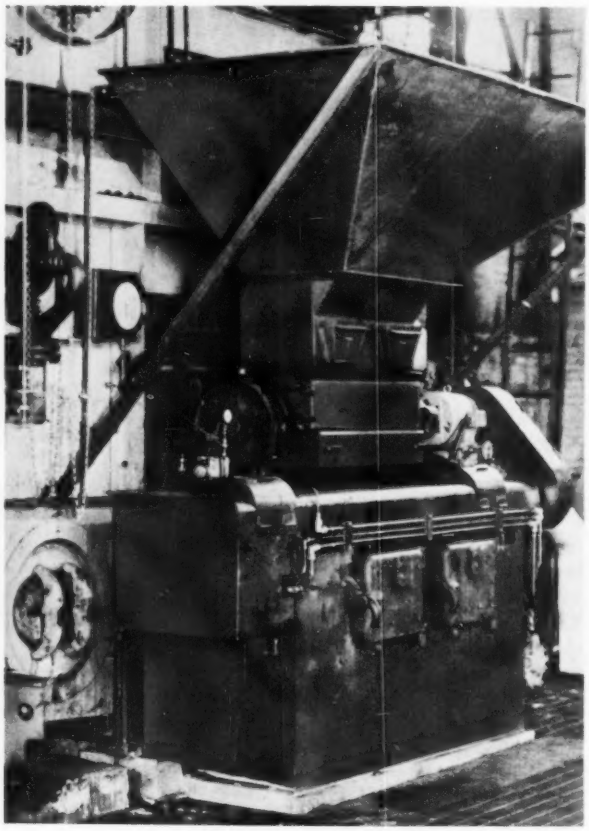
A few years ago, a stoker of this design was supplied to a government agency to permit quick conversion of a boiler unit to or from oil and gas firing. Developed to slide bureau-drawer fashion under the shop-assembled watertube boiler, the hopper arrangement could be detached and another front plate with a burner assembly could be bolted into place.

Spreader stoker for packaged watertube units is shown in Fig. 12. Such stokers provide coal-feed rates from zero to maximum while satisfying a wide steam demand.

Available in pulsating grate, chain grate, spreader and underfeed types, stokers in existing installations are proving out the practicability of coal-fired packaged boilers.



11 Overfeed stoker employing an oscillating grate designed to burn a wide range of coals points up trend toward solid-fuel firing



12 Other stoker designs, too, are making a strong bid for the same degree of automatic control now being obtained with gas and oil

Combustion controls

Control system for modern packaged boilers generally includes ignition proving, combustion control, flame-failure equipment, safety shutoff valves, limit switches, plus startup and shutdown programming. Control senses and makes boiler respond to changes in steam demand to point of shutting unit down when steam needs drop to zero. And, if an unsafe condition arises, boiler locks out.

Automatic regulation of fuel feed, in proper ratio to air supply, is the basic job for combustion control. Initiating impulse comes in response to steam-pressure change.

The three basic combustion control schemes, sketches, right, are: (1) on-off (2) positioning (3) metering.

On-off system works between two steam pressure levels to start and stop both air supply and fuel feed. The simplest control, it has a minor drawback in that during the off period, natural draft through furnace carries away heat, lowering operating efficiency.

Positioning system response to steam pressure assumes, for example, that a given damper position will provide sufficient air for a given fuel flow to hold a constant fuel-air ratio throughout load range. Yet, at any position, air flow may be influenced by voltage variations at the blower motor, draft loss through the boiler caused by soot or slag and other variables. Thus, though system may hold steam pressure constant, combustion efficiency may not stay at a high level.

Metering type control goes a step beyond positioning setup by actually measuring fuel and air flows, draft loss. These values are balanced against signals for more or less steam pressure. Result is compensation for variables which tend to influence the positioning system's operation.

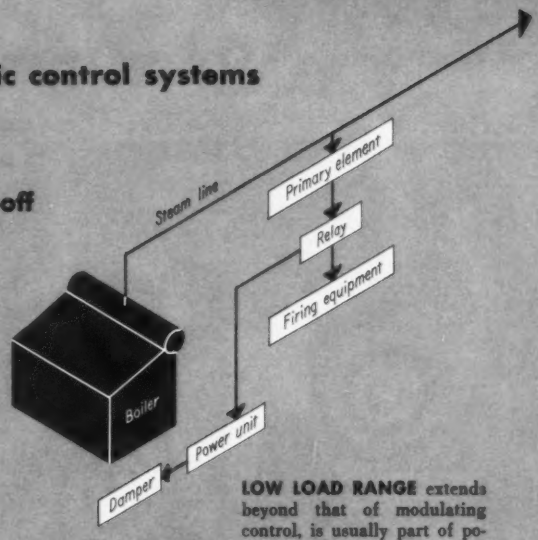
Briefly, metering control yields top precision, and this higher precision is important when a packaged boiler is operated under fluctuating loads for long periods. Even a small gain in fuel economy can often justify the added expense of metering control.

Generally, both positioning and metering systems include an on-off feature, extending low-load range beyond that of modulating.

Today's combustion controls are available with hydraulic, electric or pneumatic relays to transmit impulses to control points. Now, let's see how combustion *safeguards* are integrated with these controls.

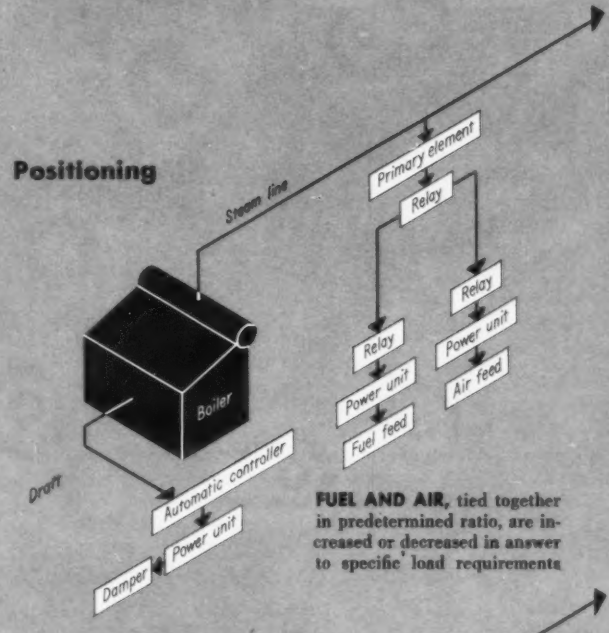
Basic control systems

On—off



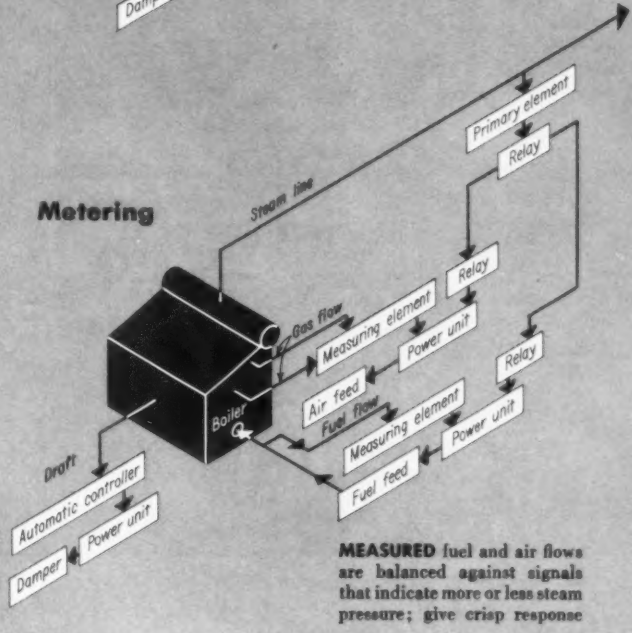
LOW LOAD RANGE extends beyond that of modulating control, is usually part of positioning and metering control

Positioning

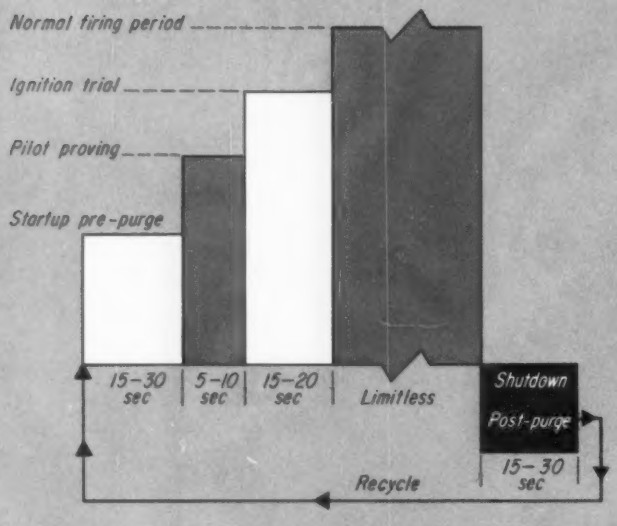


FUEL AND AIR, tied together in predetermined ratio, are increased or decreased in answer to specific load requirements

Metering



MEASURED fuel and air flows are balanced against signals that indicate more or less steam pressure; give crisp response



Typical programming sequence

It isn't enough that a packaged boiler control system provide for efficient combustion. It must also be capable of automatic and safe normal starting and stopping, in addition to complete shutdown if an unsafe condition arises. So the modern packaged boiler control system is a combination of both combustion controls and operation safeguards. As such, it is generally referred to as the boiler's program control system.

Regardless of the method used to properly proportion fuel and air, programming controls are included for governing firing equipment behavior from startup to shutdown. Flame failure and safety interlock equipment are included.

The basic job of programming controls is to take over the human operator's role during (1) initial operation from a cold-start position (2) normal operation throughout load demand range (3) handling shutdown.

Safety interlocks take over if . . .

- Low water or overpressure develops
- Fuel's too cold or pressure's low
- Pilot or flame fails
- Purging air isn't available

Safety controls

Automatic controls, while doing their job of following load demand and maintaining steam pressure, also serve a safety function in sensing danger. It's in this latter area that they render their biggest service.

Programming-sequence controls safeguard the boiler throughout the operating cycle, sketch, left. On startup, purge operation forces air through the furnace and gas passes to clear out any combustible gas pockets.

Ignition is next. Depending on the fuel, the ignition system may be electric spark, light oil-electric (spark ignites a thin oil which in turn touches off main fuel), or gas-electric (spark ignites a gas pilot).

A flame scanner is on the job during ignition. Control system won't let main gas or fuel oil valve open unless scanner indicates ignition is normal (ignition proving). Even after lightoff, the scanner continues to supervise the burner. If flame is lost, the scanner shuts the unit down. Following shutdown, the blower again purges the furnace and gas passes before ignition cycle recurs.

Thinking differs on gas-pilot continuity. Some designers, depending on the application, prefer the continuous pilot—one which remains in service whether or not the burner is in operation. Others feel interrupted gas-electric ignition offers more advantages. This type remains in service during burner firing but shuts down with the boiler. Usually, it is used with semiautomatic gas-fired boilers and, if adopted, requires that on boiler restarting the furnace be purged, gas pilot be reignited, and fuel flow be initiated manually. An electrical interlock prevents purging or reignition of the pilot when a fuel valve is open.

While it is possible to scan both burner flame and pilot with a single scanner, some designers prefer separate devices.

Low-water cutoff, separate from programming sequence control, is an extremely important device in the general safety area. Its job: Shut down the boiler immediately if water drops to a dangerously low level.

Basic types of low-water cutoff, sketches right, are symbolic of those used with packaged boilers.

Design, top sketch, uses a ferrous plunger on one end of a float rod. Plunger slides within a nonferrous sleeve. A permanent magnet with mercury switch affixed is supported by a pivot adjacent to the nonferrous sleeve.

Under normal water conditions, the ferrous plunger is above and out of reach of the magnetic field. Since in this position the mercury switch lies in a horizontal plane, the burner circuit is kept closed. But, if boiler-water level drops, the float drops, bringing the ferrous plunger within the magnetic field. Then, magnet swings through a small arc toward the plunger; the mercury switch tilts, opening the burner circuit.

Design, center sketch, uses a float connected through a linkage to a plate supporting a mercury switch. Plate is horizontal in the normal water-level position, so switch holds the burner circuit closed. If water level drops, the float drops, tilting the plate so the switch opens the circuit.

Submerged electrode, bottom sketch, uses the water proper to complete the burner circuit. If water level drops below electrode tip, current flow is interrupted and burner shuts down. On firetube boilers, the low-water cutoff generally includes an intermediate switch that controls the feed pump.

Completely automatic in operation, these low-water cutoffs call for a minimum of maintenance. Yet insurance company and boiler makers' records show an astounding number of boilers being destroyed or damaged annually simply because of low water. And, in most cases, damage is traceable to failure to provide even minimum maintenance. In an attempt to counteract this, the trend is toward installation of a second low-water cutoff to back up the first. Though based on the theory of doubled protection, this doesn't mean that maintenance of either control can be slighted.

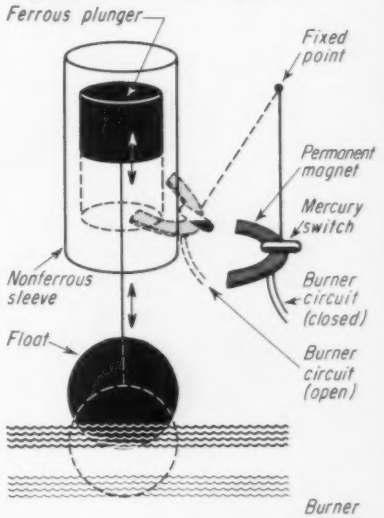
The more intricate and elaborate a system of controls, the more competent must be the operator. Expensive and carefully designed installations have been damaged through ignorance, dislike of equipment, or intentionally bypassing or blocking out controls that the operating or maintenance man doesn't fully understand. Too often, these controls are the most important safety devices.

Properly supervised and maintained, the integrated equipment in today's packaged boilers will give long life, top performance.

These are basic low-water cutoff types

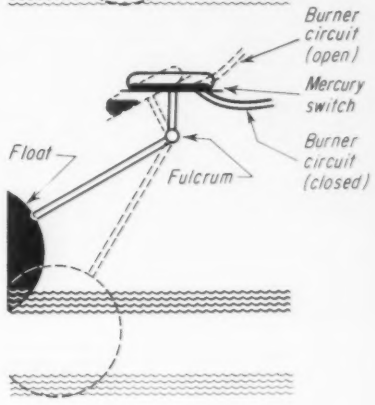
Float-magnet

Encased in a nonferrous sleeve, ferrous plunger on float rod stays out of permanent magnet's field during normal water-level period. A switch on the magnet holds burner circuit closed. Lowered water drops float, magnet swings in to plunger, tilts mercury switch and opens burner circuit



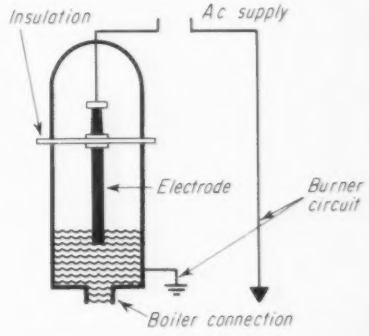
Float-linkage

Float is connected through linkage to a plate supporting a mercury switch. On a horizontal plane during normal water-level period, the switch holds burner circuit closed. Lowered water drops float, linkage tilts plate and attached mercury switch, opening the burner circuit



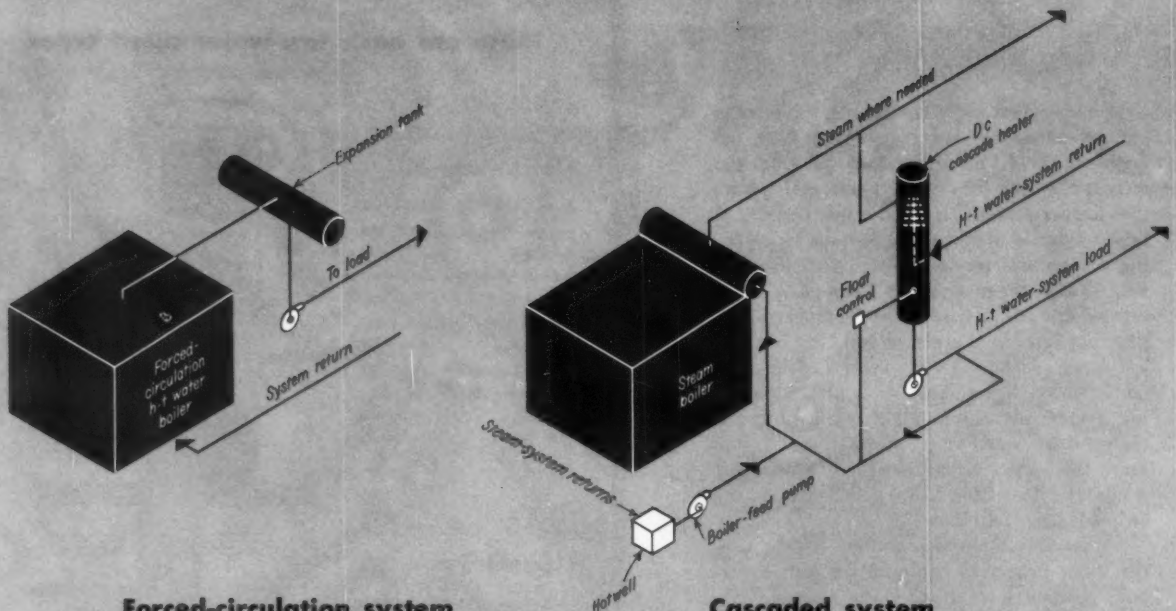
Electrode probe

An electrode, insulated from its grounded housing, is partially submerged during normal water-level period. In series with the burner circuit, current flows from electrode through water to housing to hold burner circuit closed. Lowered water bares tip, breaks circuit to burner



Fittings, devices meet high standards

Like all boilers, packaged firetube and watertube units include safety valves, pressure gages, water columns, feedwater regulators, blowoff valves, steam and water valves, refractory materials and other equipment generally not produced by the boiler manufacturer. However, the latter selects these appurtenances from makers who themselves have established a reputation for quality products. Engineered to exacting standards to meet operating conditions found in packaged boilers, these fittings and devices merge into the packaged boiler's pattern of integrated overall design. It's customary for each packaged boiler maker to select this equipment in standardizing his unit. And, of course, standardization results in a saving for the user. However, the user may choose a device or fitting of his own preference. This holds for firing equipment, control systems, too.



Forced-circulation system

Generally has separate tank which absorbs expansion when water temperature rises. Pump draws from tank, circulates water through system and back to the boiler

Cascaded system

Steam goes to direct-contact heater, raising water temperature. H-t water is pumped from heater, through system, back to heater. Separate pump feeds boiler

High-temperature water

These systems are drawing increasing attention

Throughout this report we looked upon boilers as steam generators. We touched briefly on thermal-liquid heaters and application of packaged units for high-temperature-water systems. Packaged-boiler manufacturers, fully aware of the advantages to industry provided by h-t water for some applications, have developed equipment specifically designed for this service. (POWER, Jan 1957, pp 75-78.)

One advantage of high-temperature water systems lies in the use of a closed system. This immediately minimizes corrosion and water-treatment problems. And, within this closed system, the boiler, circulating pumps, distribution piping and local heat exchangers are all part of an integrated scheme.

Two basic types of high-temperature water systems are (1) forced circulation and (2) cascade. See sketches, above.

Forced-circulation system generally has a separate tank which absorbs expansion as water temperature changes. A centrifugal pump draws water from this tank, circulates it through the system, returns it to boiler for reheating, then back to tank to complete cycle.

Some designers prefer using two pumps; one to circulate water between boiler and expansion tank, the other to circulate water between expansion tank and system. A variation on this hookup is to pipe the system return directly to the boiler circulating pump. In both 1- and 2-pump systems, spare pumps may be provided to cope with pump failure and provide for routine maintenance.

Although the 2-pump system tends to reduce pumping costs, these savings must be carefully balanced against higher first cost and increased maintenance for double pumps.

Cascade system takes steam from a boiler and carries it to a direct-contact heater that raises water temperature to about 2 F of entering steam temperature. From the heater, pumps circulate the high-temperature water to heat exchangers at points of use. Steam may also be taken from the boiler drum for use as desired. Return condensate generally is to a hotwell. Feedwater may be supplied from both the hotwell and water portion of the direct-contact heater.

Theoretically, any steam-generating unit

can be used in a cascade system. This proves an attractive feature to existing boiler plants wishing to convert from steam to high-temperature water or a combination of both.

In some instances where natural-circulation firetube boilers were used as forced-circulation water heaters, leaking tubes and cracked ligaments in tube sheets resulted. However, with suitable provision for introducing returning lower-temperature water without thermal shock to the unit, the conventional steam type firetube packaged boiler may be adapted to forced-circulation systems.

Present research by firetube boiler manufacturers is aimed at developing a unit with rearranged heating surface and flow and return connections that will satisfactorily serve in a forced-circulation h-t water system.

Fig. 2 points up present thinking along this line. To date, operating results with this firetube design appear successful. In the watertube field, Fig. 1 and 3 show two variations of the LaMont type forced-circulation boiler.

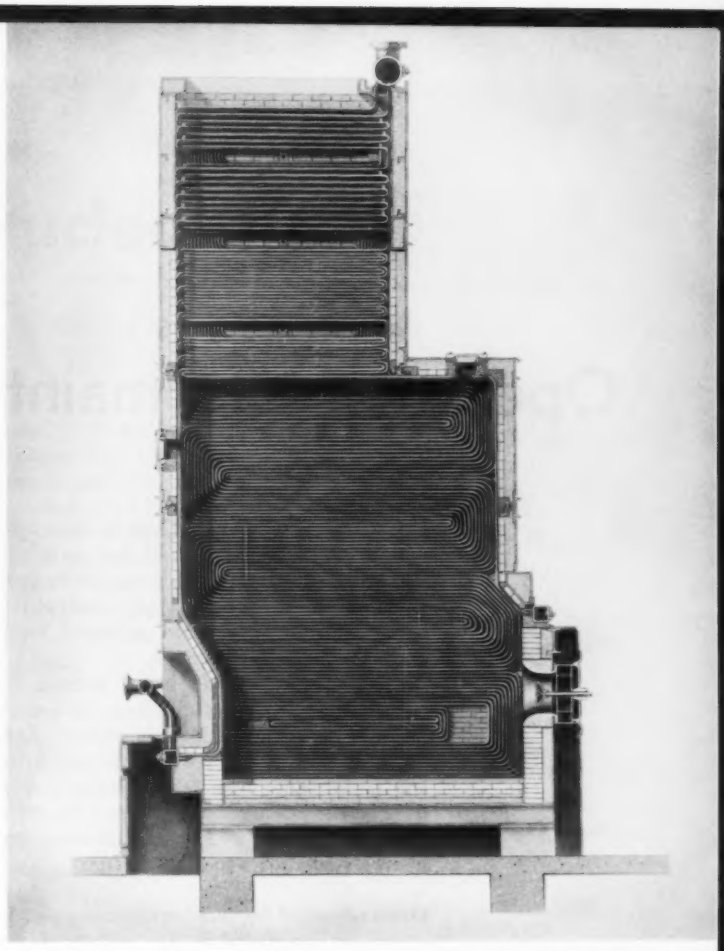
These boilers have no drum, use orificed tubes for proper water distribution. Positive and controlled water circulation permits high heat absorption per unit of heating surface. At the same time, uniform water distribution eliminates danger of tube overheating. One other feature of the LaMont design is its low space-weight-capacity ratio. Closely spaced, small-diameter tubes yield a large heating surface per cu ft of boiler space.

Thermal liquids is the term most generally applied to synthetic fluids used for heat transfer. Because of a high boiling point, they can be operated at or near atmospheric pressure. Two basic fluid types used in this area can be distinguished by their method of heat transfer: *liquid phase* or *vapor phase*.

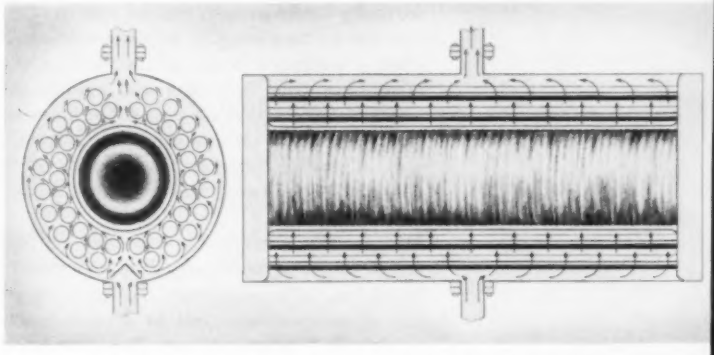
Fluids in the former class can be heated to a maximum recommended temperature of 600 F, which is about 50 F below boiling point. Ordinary firetube and watertube units, depending solely upon convection, perform satisfactorily only at relatively low temperatures. Where temperatures in the 500 to 600-F range are required, a forced-circulation type heater is usually recommended.

Heaters for the synthetic liquid-phase heat-transfer fluids may be fired with fluid or solid fuels. Portable and small-sized stationary units may be electrically heated.

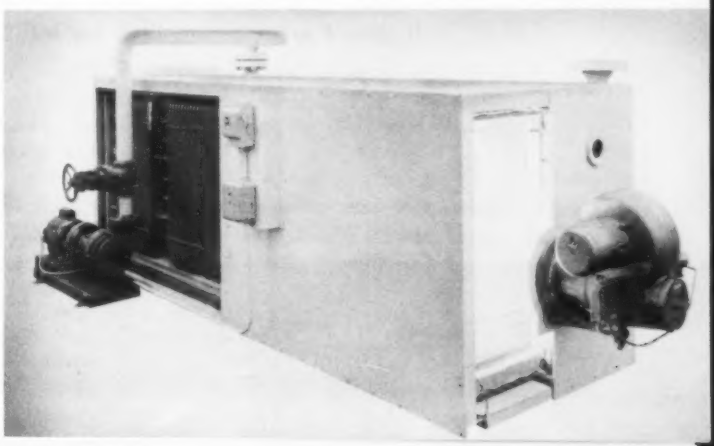
Vaporizers used with vapor-phase fluids resemble conventional boilers. But, because of fluid's characteristics, operating temperature is usually limited to about 700 F. The vapor system is of the closed type where all condensate returns to the vaporizer.



1 This design approach in the LaMont type controlled-circulation boiler was developed exclusively for high-temperature water system use



2 In the firetube area, high-temperature water design accent is on provision for lower return temperatures without thermal shock to the unit



3 Another LaMont type forced-circulation design. LaMont boilers have favorable space-capacity ratio →

Operation and maintenance

Manufacturers of packaged boilers are accenting the ease in installation of their units and the availability, if wanted, of completely automatic operational control. Don't construe this latter feature to mean the packaged boiler needs absolutely no attention.

After installation and initial startup, the manufacturer will want to adjust the boiler's firing equipment and control system. Even though the unit may have been through firing and performance tests in the maker's shop, these on-the-job minor adjustments are necessary to compensate for local conditions created by user's location and application.

Once adjusted for peak performance, control system settings should remain unchanged. But if further adjustment is necessary, don't tinker: call the manufacturer's field man. Control maker's files are bulging with reports on faulty boiler-burner, control system operation due to tampering or experimentation. So when a packaged boiler is installed in your plant have your operating and maintenance men study the maker's supplied literature and have them follow recommendations. Naturally, some minor adjustments can be made by the operator by following maker's instructions.

However automatic the unit may be, some maintenance is necessary. The self-cleaning boiler has yet to be invented. All fuels, regardless of composition, tend to deposit residue on fireside heating surfaces. Too, elements in present fuels may cause heating-surface corrosion, tending to reduce strength and leading to possible failure.

Combustion deposits cut heat-transfer rate. If allowed to accumulate, draft loss will increase while gas flow drops. Rise in exit gas temperature may indicate that fireside surfaces are becoming fouled. So periodic inspection and cleaning of fireside surfaces is a must if top performance is to continue.

During inspection have your men pay particular attention to the low-water cutoff. See that this control is frequently tested to make sure it's in operative condition. As recommended by the manufacturer, the device should be completely dismantled, cleaned, inspected, tested, then returned to service. It is a matter of record that many boilers fail every year simply because proper attention wasn't given to the low-water cutoff.

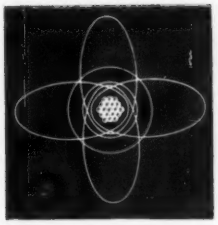
Constant evaporation and water makeup in all boilers tends to concentrate suspended solids. They must be removed at intervals, or continuously, to avoid too high concentrations. If blowdown is not governed by water analysis have it done at least once every 24 hours, at a time when steaming rate is lowest.

Amount and frequency of blowdown ties in with your water-treatment program. And, in the broad area of treating water for your packaged boiler, individual analysis is still the soundest approach to prescribing effective water treatment. There is no excuse today for operating a boiler where inefficiency or severe local overheating results from the lack of proper water treatment. Effective water treatment is presently available from a number of specialists in the field.

Remember, the boiler designer and manufacturer have no control over your maintenance—it's your responsibility. Slight on maintenance and you can't expect to continue getting top performance from your unit.

Reprints available

Reprints of this 24-page special report are available by writing to Reader Service Department, POWER, 330 West 42nd Street, New York 36, N. Y. There is a charge of $.75 for single copies. Discount on quantities: 10 to 99, 10%; 100 to 999, 25%; 1000 and over, 40%



Nuclear notes

By B G A SKROTZKI, Associate Editor

Power-reactor roll call shows 23 projects running or scheduled in the U. S. that will have total capacity of about 1300 mwe by 1964. These are:

1. Experimental breeder reactor No. 1, Arco, Idaho—0.2 mwe (running) EBR
2. Boiling-reactor experiment, Arco, Idaho—5 mwe (running) BORAX
3. Experimental boiling-water reactor, Lemont, Ill.—5 mwe (running) EBWR
4. Sodium-reactor experiment, Santa Susana, Calif.—7.5 mwe (running) SRE
5. Vallecitos boiling-water reactor, Vallecitos, Calif.—5 mwe (running) BWR
6. Organic-moderated reactor experiment, Arco, Idaho—16 mwt (running) OMRE
7. Homogeneous reactor experiment, Oak Ridge, Tenn.—0.3 mwe (running) HRE
8. Shippingport power station, Shippingport, Pa.—60 mwe (running) PWR
9. Commonwealth Edison Co, Dresden, Ill.—180 mw (building) BWR
10. Consolidated Edison Co, Indian Point, N.Y.—273 mwe (building) PWR
11. Power Reactor Development Co, Monroe, Mich.—100 mwe (building) SCBrR
12. Yankee Atomic Electric Co, Rowe, Mass.—134 mwe (building) PWR
13. Experimental breeder reactor No. 2, Arco, Idaho—15 mwe (building) EBR
14. Rural Cooperative Power Assoc, Elk River, Minn.—22 mwe (projected) BWRC
15. City of Piqua, Ohio—12.5 mwe (projected) OMR
16. Consumers Public Power District, Hallam, Nebr.—81 mwe (projected) SGR
17. Chugach Electric Association, Anchorage, Alaska—10 mwe (projected) SDR
18. Northern States Power Co, Sioux Falls, S.D.—66 mwe (projected) BWRF
19. Carolina-Virginia NPA, Parr Shoals, S.C.—19 mwe (projected) PWR
20. Pacific Gas and Electric Co, Humboldt Bay, Calif.—50 mwe (projected) BWR
21. Pennsylvania Power and Light Co, Pa.—150 mwe (projected) HRS
22. East Central-Florida West Coast Groups, Florida—50 mwe (projected) GCHWM
23. Gas-cooled power reactor—AEC proposal

Key to reactor types:

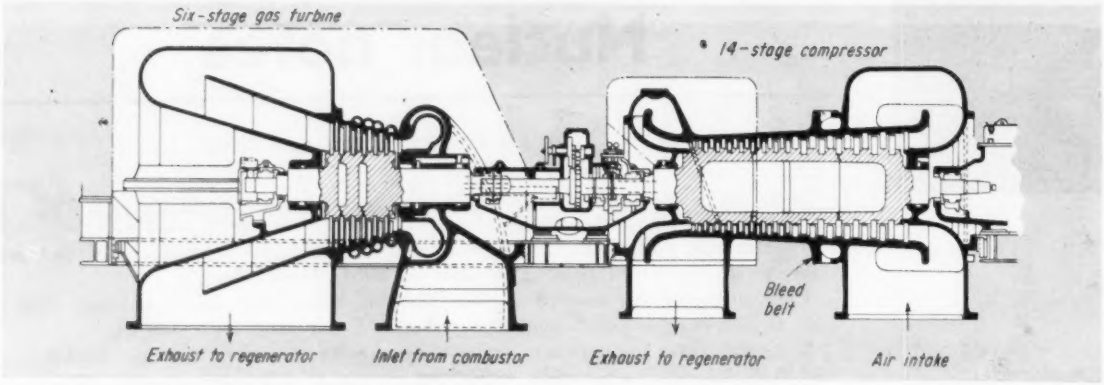
BWR—Boiling water
BWRC—Closed-circuit boiling water
BWRF—Forced-circulation boiling water
GCHWM—Gas-cooled and heavy-water moderated
HRS—Homogeneous, single region, slurry
NPA—Nuclear Power Assoc
OMR—Organic-moderated and cooled
PWR—Pressurized-water moderated and cooled
SCBrR—Sodium-cooled fast breeder
SDR—Sodium-cooled heavy-water moderated
SGR—Sodium-cooled graphite-moderated

This list does not include any military power reactors

Record power surge of 530 mwt in less than one second was generated by AEC's KEWB (kinetic experiment on water boilers) reactor which automatically shut itself off without damage. Atomics International designed and built the reactor, a 50-kw aqueous homogeneous type fueled with a solution of U-235; they also run it for the AEC in Santa Susana, Calif.

Boiling-water reactor, 15-mw capacity, has been proposed for installation in Puerto Rico. AEC would furnish major share of $11 million cost and own the reactor, which would supply power to the island's electric system. Design by General Engineering Corp includes possible use of nuclear superheating.

Harbor excavation by nuclear explosives seems a possibility and will undergo intensive study as an item in Project PLOWSHARE of the AEC. Northwest Alaska above the Arctic Circle between Cape Seppings and Cape Thompson could use a harbor to give access to mineral deposits and aid fishing activities. U. S. survey parties will visit the area this summer to get cost, topographical, geological and oceanographic data. If found safe and practical, harbor could be made in 1960.



1 Six-stage reaction gas turbine drives 14-stage axial compressor developing a 4:1 pressure ratio and couples to generator and blast-furnace gas compressor through gearing at right. Turbine and compressor turn at 5350 rpm, the generator at 3000 rpm

First steel-mill gas turbine in Britain...

burns blast-furnace gas to produce 2500-kw net output with 1200-F inlet gas temperature. Unit uses three regenerators in parallel and a single combustion chamber

By PHILLIP C SECRETAN, Technical Editor, *The Shipping World*, London

Tests on a 2500-kw gas turbine have been completed by Richardsons Westgarth (Hartlepool) Ltd, England, for Shelton Iron & Steel Ltd. These show that the unit can develop its rated output at well below the rated 1200-F inlet gas temperature to the turbine.

Fig. 2 shows the unit regenerative cycle which features a 6-stage centrifugal compressor for the blast-furnace gas, two regenerators in parallel for the air and one for the compressed gas. The single combustor will burn either blast-furnace gas or oil. A recirculation line parallels the gas compressor. Main specifications for the unit are:

Air inlet, F	60
Turbine inlet, F	1200
Air compressor ratio	4
Air flow, lb per sec	30.5
Exhaust-gas outlet, F	450
Regenerator effectiveness, %	75
Turbine and compressor rpm	5350
Generator rpm	3000
Gas-compressor rpm	7970
Starting-motor kw	142
Overall thermal efficiency, %	20.5

Compressor air enters the cycle through two multiduty automatic self-cleaning viscous type filters.

Fig. 1 shows the gas turbine and air compressor. The cast-iron compressor casing consists of two parts split horizontally. The rotor is built up of three nickel-manganese-molybdenum steel forgings welded together along the circumferential joints.

Labyrinth glands of thin stainless-steel strips seal the shaft penetrations. A bleed belt at the fourth compressor stage supplies sealing air to the glands at the compressor inlet and exhaust.

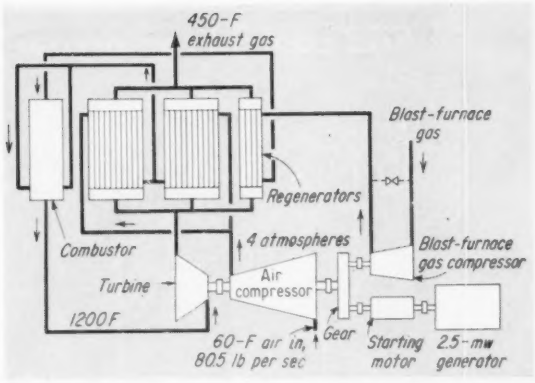
The gas turbine also has a horizontally split casing with a separate exhaust hood. The turbine-entry and cylinder sections are alloy ferritic steel castings. The exhaust section is partly cast and partly fabricated from molybdenum steel plates.

Inlet of the turbine has a lining fabricated from 5%-chromium steel plate. This protects the outer casing from full gas temperature because cooling air from the compressor flows between lining and casing. This air enters the main gas flow at the ends of the first row of stator blades and helps cool them also.

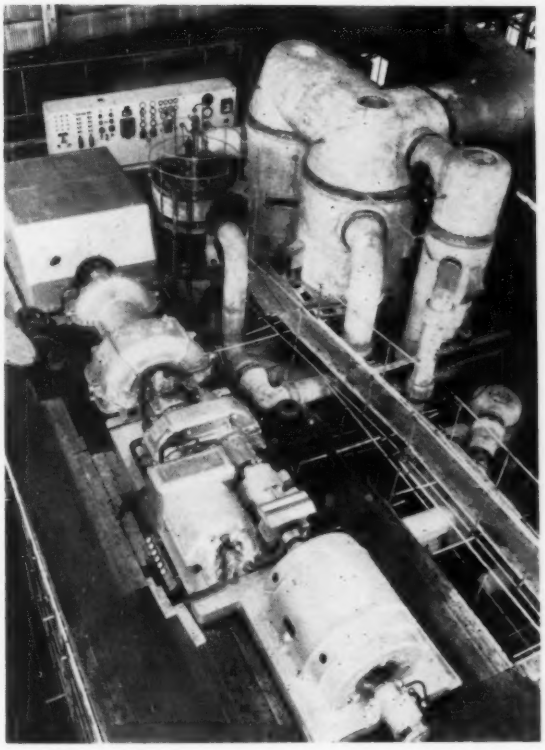
Cooling air flows too through ducts surrounding the turbine cylinder, through the rib in turbine inlet and over the inlet end of the turbine rotor. Labyrinth glands seal the shaft as in the compressor.

The rotor and stator blades are made of 17/13 stainless steel. Water nozzles at the turbine inlet will make blade washing easy.

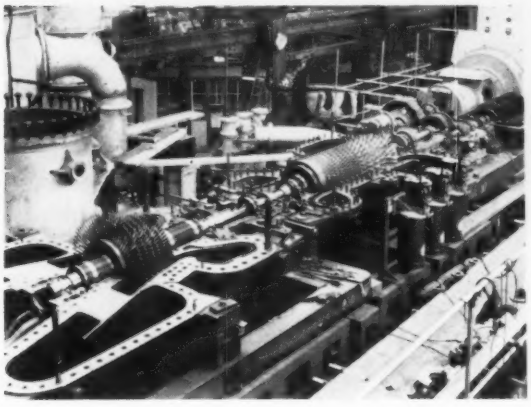
Combustion chamber fabricated



2 Single-shaft open-cycle unit uses regenerators to heat both compressed air and fuel gas; will burn oil as alternate fuel



3 Unit stands on test bed, turbine hood at upper left, combustor, regenerators at right; air compressor, gearbox, gas compressor next to starting motor, generator, from top to bottom



4 Turbine, air compressor, gears, 6-stage centrifugal blast-furnace-gas compressor, generator are shown, left to right

from molybdenum steel plate has an inner lining carried on three concentric rings with increasing diameter, the lowest one being the largest. The rings carry thin steel tiles welded on the back face. Cooling air flows between tiles and rings into the flame space.

The lower portion of the inner lining forms a double wall; cooling air enters through holes in the lowest section of the inner lining. Hand valves control the cooling air entering this last section; these are finally set during the test. Loose support of the steel inner lining allows for expansion in the outer casing.

Air from the two regenerators enters the bottom of the combustion chamber through two opposite duct connections. Part of this air flows through swirl vanes at the top of the combustion chamber to support the flame. Most of the remainder enters the combustion zone through the inner lining. A small part of the air never enters the inner lining at all, but separates out and flows through the outer part of a double-wall duct to flow around the inner lining of the turbine inlet and spill out over both ends of the first row of stationary blades.

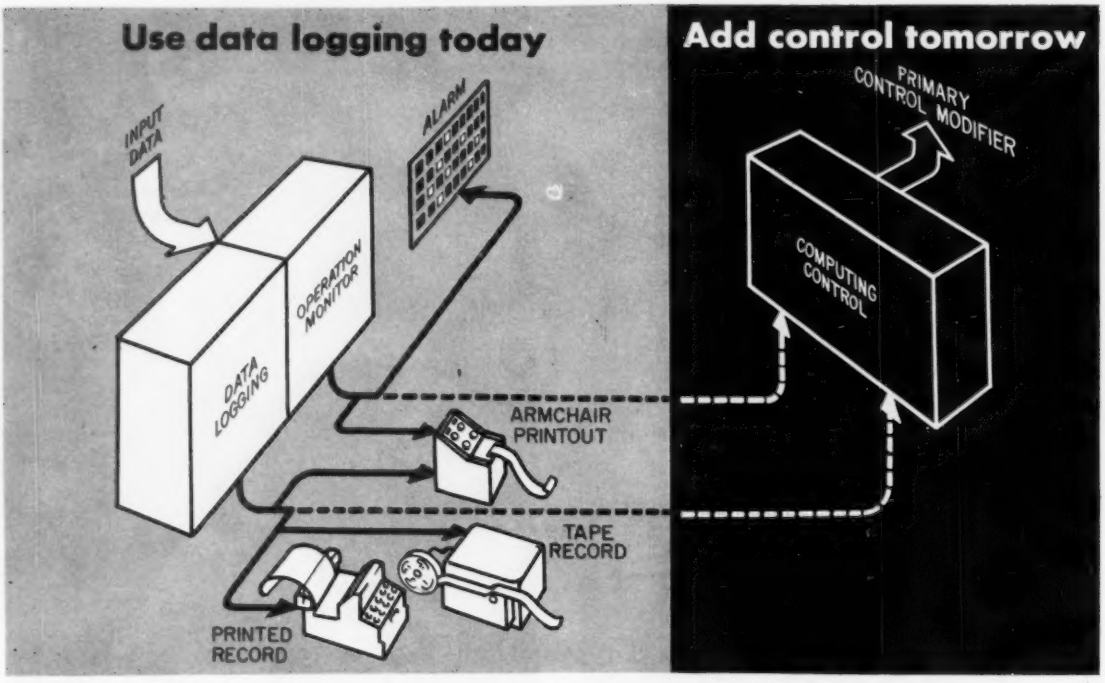
The combustor can burn either blast-furnace gas or gas oil or both; each fuel has its own burner. A glow type ignition rod energized by a transformer ignites the fuels during starting.

Rotating elements. To save space, the starting motor is inserted between the low-speed output shaft of the gearbox and the generator shaft. The generator of standard Richardsons Westgarth — Brown-Boveri design has a rated output of 3200 kva at 0.8 pf and 5500 volts. It has a coupled overhung exciter.

The standard Brown Boveri gearing can carry full power of 3200 kw for the generator and 1140 kw for the gas compressor. Thrust collars on the driving pinion bear against the rims of the gear wheels for the generator and gas-compressor drives. The main pinion and gas-compressor drive wheel are made from solid forgings while the alternator drive is a forged ring shrunk on and keyed to the central cast wheel. Gear teeth are nitrided.

The cast-iron gear casing is split horizontally on the shaft center lines. A gear type pump driven from the 3000-rpm shaft force lubricates the bearings and gear teeth.

Gas compressors on similar gas-fueled Brown-Boveri units for steel works are of the axial-flow type. For this unit, though, there were no axial-flow units of small enough capacity, so the (*Continued on page* 176)



DATA LOGGER for Louisiana Power and Light Co includes digital computer for flexible control of logging sequence and calculations. Careful design of present components allows future use in computing control system. Cost is spread out over years

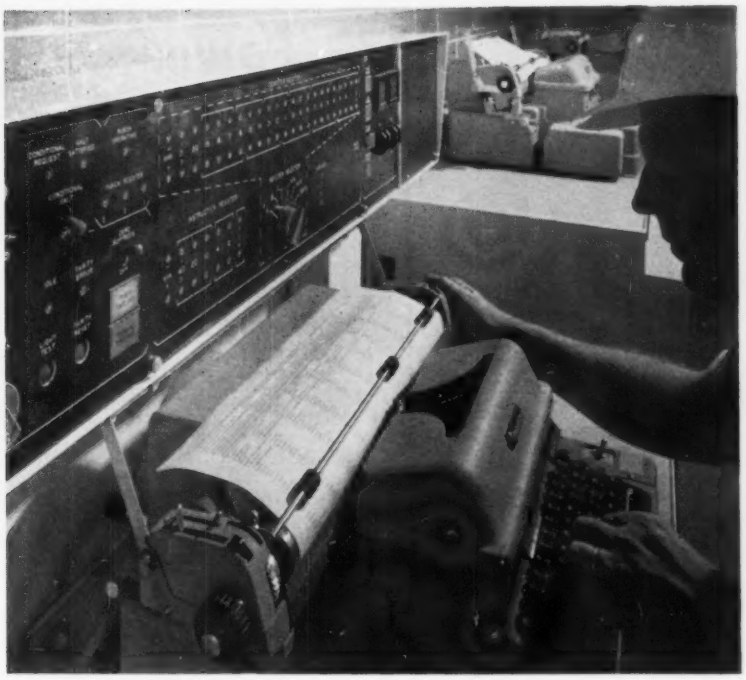
Automatic data system keeps tabs on

Louisiana Power and Light's new operational data system pioneers full-time use of digital data logging in place of standard recorders. This plant will be proving ground of several new techniques.

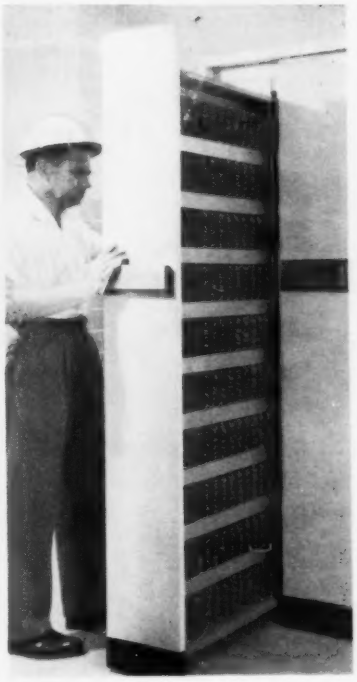
Computer-controlled power plants loom closer than ever as Louisiana Power and Light Co's newest unit goes on the line. The 210-mw unit at Sterlington Station uses the first transistorized general-purpose digital computer in the power industry. Computer is used for data reduction and logging as a regular operating guide. For the first time, continuous, accurate data on heat rate, temperatures, pressures and flows will be available to operators. While use of computers in power systems is not new, earlier installations used analog computers. This operational information system, supplied by Daystrom Systems Div of Daystrom, Inc, monitors 350 data points, eliminating need for hand logging of operating data, scan recorders, integrators and bearing monitors. POWER's *TD report* (January 1958, pp 71-77) described an overall system; here are the amplifying details.

Operators expect closer control of equipment, accurate accounting and trouble-shooting records and safer operation from use of data logging. If anything goes wrong in plant operation, records are obtainable immediately. Operators then decide whether plant equipment can be safely left in service, or if it should be tripped to prevent damage. Flexibility of the general purpose digital computer allows changes in number or sequence of data points monitored as needed, or complete changes of program with prepared punched tapes. Engineers at Louisiana Power and Light say system was not installed to save manpower, but to gain operating experience with equipment that will eventually be used in fully automatic power plants.

Data logger samples 350 data points a second. System measures 250 temperature points. It also prints 100 plant readings at regular intervals for accounting and trouble-shooting records. Computer calculations include differential temperatures, self-changing alarm settings, corrected flows and heat rates. The system consists of four major parts: *input section*, where measuring-instrument leads sequentially connect for reading; *digital section*, where analog signals are converted to digital values; *computer section*, which controls all logging-system operations and performs mathematical calculations; *output section*, where



CONTROL CONSOLE and input typewriter let shift-control operators modify logging sequence or alarm set points to suit conditions. Typewriter records any changes made



ROLL-OUT SECTIONS house transistor units for easy checking without shutdown

Sterlington power plant

By L E STEWART, Assistant Editor

final logging, printing and annunciation occurs.

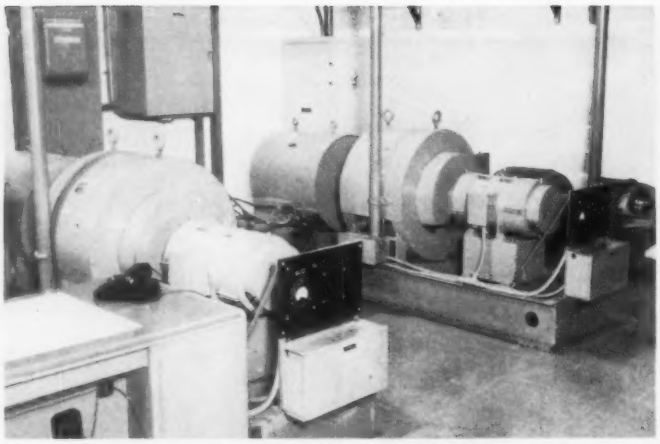
Digital section includes Daystrom's *Dadit* analog-to-digital converter. *Dadit* does not require amplified analog signals, and is capable of resolution of better than one microvolt. Input analog signals balance by feedback, resulting in a continual check for grounds or open-circuiting.

Transistorized computer is the heart of the new system, controlling all other sections besides performing computations and logical decisions through random-access magnetic-core memory. Circuits are packaged on printed circuit boards and are temperature compensated. All components can run comfortably without air conditioning to 120 F. Magnetic core memory unit stores 2048 different pieces of information, and provides for increasing storage to 16,384 pieces. System assigns definite figures to the incoming signals, such as voltages produced by thermocouples. Temperatures are calculated by computer using stored thermocouple calibration curves. All calculations are performed digitally with an accuracy of one part in one million. Computer program controls warning function and compares each reading against desired limits. Out-of-limit readings trip annunciator panel lights and horn. Operator's alarm printer immediately prints out time, reading and location in plant.

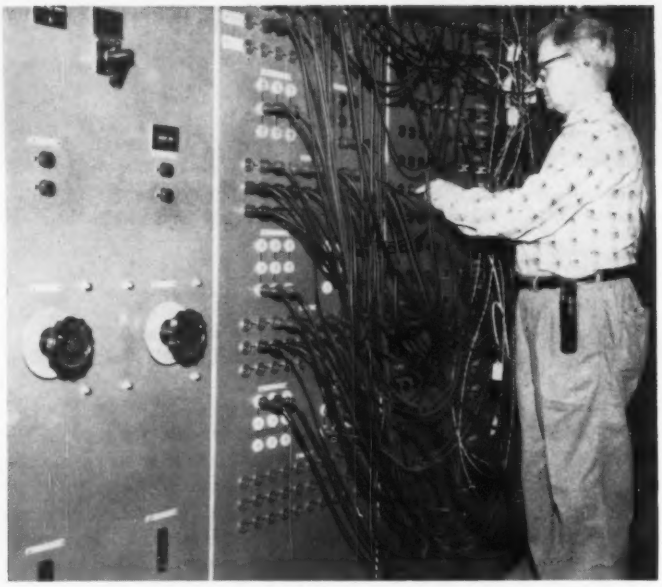
Output section includes logging and warning systems. Logged data are punched out by high-speed punch faster than the tape-reading typewriter can operate. Result: data records on punched tape in less than one minute while the two typewriters continue for several minutes. Alarm printer is 11-digit machine capable of printing 5 lines per second. It's in a small cabinet in operator's control panel, and is designed for mounting on the arm of control-room operator's chair. Point identification and value of abnormal reading are immediately available to the operator.

Control console for data logger monitors system and changes computer program as needed. Program information for computer is introduced by the console typewriter through punched tape or manual entry by keyboard. Since information enters through the typewriter, all entries are permanently recorded.

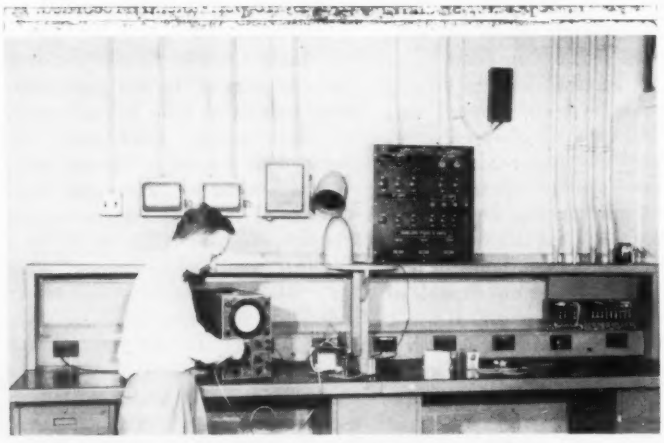
Engineers for Louisiana Power and Light Co, and Ebasco Services, Inc, designers of the new plant, combined talents to take full advantage of data-logging techniques. All parties look foward to the day when control variables are sufficiently well-known to allow fully automatic computer control. This would be a so-called continuous computer scanner, where automatic equipment, supervised and controlled by computer, would take over startup, operation and shutdown of the entire plant. Daystrom engineers state that the present logging system can easily be programmed for complete computer control at a later date.



Special voltages generated here . . .



are shunted through patch panel . . .



to satisfy precise laboratory needs

NO. 16: INDUSTRIAL LABS

Planned expansion in the research and development area places heavy emphasis on tomorrow's lab wants. Arma's experience points up the need to . . .

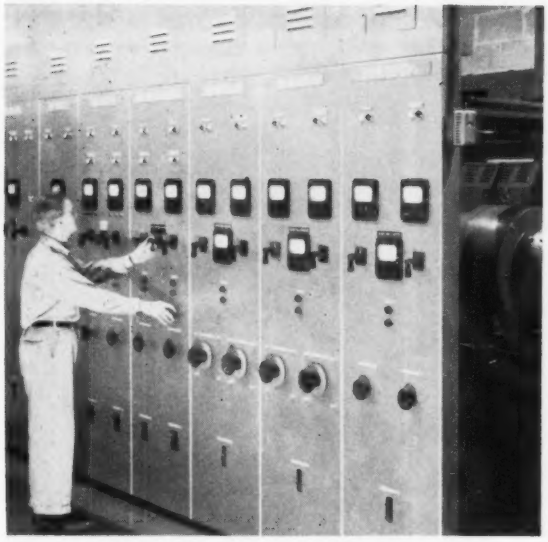
Lay out a

By JOHN CAMMARATA, Arma Div
American Bosch Arma Corp

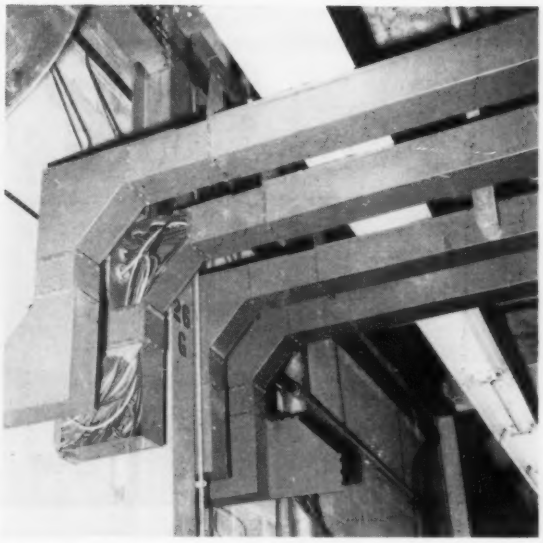
There's one thing you can be sure of: lab design has now and will continue to assume a degree of complexity to match that of present-day instrumentation. Only 20 years back, voltages other than 120/240 dc and 120/208/440 ac at 60 cycles were considered highly specialized for a laboratory. But the picture has changed plenty. To get perspective on the degree and magnitude of this change, let's look at Arma's experience over recent years.

Flexibility has always been a key factor in our design plans. It has to be—our development work must always be ahead of the fast-changing needs of our customers. So when we designed labs in our present Roosevelt Field location (Garden City, N. Y.) we took a hard look at work load on hand, then projected requirements for the future.

Primary supply came from Long Island Lighting Co at 13.2 kv. A big single stepdown was made to 208 v, 4 wire. Beyond this, all voltage needs and frequencies were to be produced



POWER PANEL permits selecting variable voltage and frequency outputs of power bay. Lab test needs will vary over a wide range



WIRING DUCTS proved themselves most practical for accommodating changing needs in circuits feeding to and from laboratories

sound PTG plan for multivoltage labs

in the plant. That went for dc, too.

Customary cost study in terms of $ per kva didn't help much here because of the host of special requirements. Typical: loads and their electrical supplies often had to be isolated; generators had to be connected so several areas could be fed if any one mg set failed; changes in generator voltages were expected.

This last factor, changes in generator voltages, came about because of our customers' changing needs. For example, most naval applications use 120-v 3-ph 400 cycles while aircraft applications call for 200-v 3-ph 400 cycles. For any given period, lab work may be equally divided between naval and aircraft developments, but this can change fast. That's why flexibility is a top consideration in any of our long-range projections. It means changes can be accommodated without making installed equipment obsolete. *In dollars this comes to a fraction of what it would if not planned.*

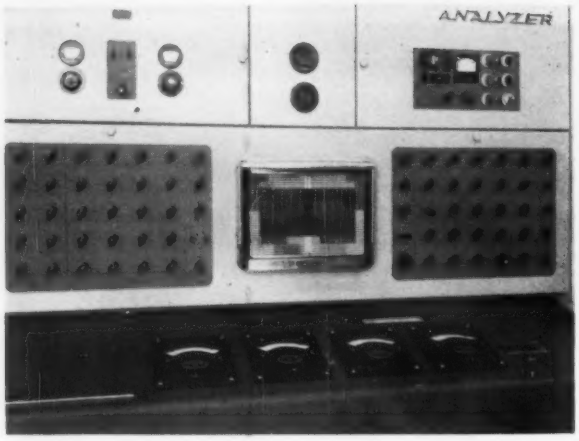
Load study indicated use of a central power bay where the many supplies would be generated, controlled, distributed to the labs. An adjunct power bay supplied the essentially heavy power needs. This power bay or load-center principle was a natural because of heavy test surges forcing generator leads to be kept short. Separate generators were specified, rather than one large one, to insure that there would be no interaction between equipment under test.

Precision voltage and ripple requirements of some test equipment posed special handling problems. Then there was an installation calling for about 200 hp in motors driving compressors which would cycle frequently. In both these instances the power feeds and actual equipment were placed outside the main power bay. Once these problems were disposed of, the big job still remained of providing for specialized voltages, frequencies and patching to labs and test areas. By patching we mean the temporary jumper scheme (see center photo, facing page) where through a central point different voltages and frequencies can be shunted to any lab.

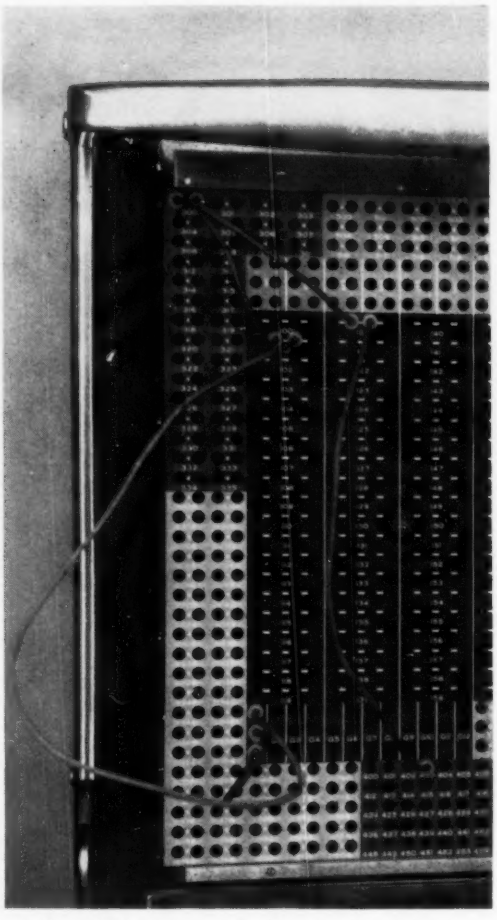
Load classifications came under the general heading of dc, ac and signal. Naturally, all ac and dc runs are separated in any medium or long run feed. Conduit was the accepted raceway in past years. But to get the flexibility we needed, we used a network of 4- and 6-in. sq ducts. Removable duct covers simplified adding new feeders. Two duct runs were used; one for dc, the other for ac and shielded twisted pair signal leads.

Feeder sizing centered about voltage-drop limits. And that meant designing for the worst conditions, still keeping top flexibility and growth in mind. A generous PTG index was applied to all feeders to cover future expansion.

Voltage needs of labs were divided into two classifications: those to be permanently distributed to each lab bench and those to be handled through the patch panel. In the former group were 120 v, single ph, 60 cycle; 120 v, 3 ph, 60 cycle; 208 v, 3 ph, 400 cycles; 180 and 270 v, dc. Other voltages and frequencies produced in the power bay are distributed via the patch-panel scheme. Some of them are: variable voltage, 3 ph, 320-1000 cycles; 0-200 v, dc, in 2-v



CONTROL CENTER links patch panel, *center*, metering, controls



PATCH PANEL mounts on cabinet in front of operator

Patch panel aids new network analyzer

First electric network analyzer, designed specifically for engineering education, went into service recently at Lehigh University, Bethlehem, Pa. The computer-like unit can simulate the power system of an entire small town or electric utility.

Well-suited for college-lab use, this is the first of an expandable building-block design developed for small users by I-T-E Circuit Breaker Co. Basic unit includes three generators and 24 circuit elements. Lehigh's analyzer combines six generators and 62 circuit elements. With it, a complete electrical system can be duplicated by values of circuit components.

steps, battery supply; 18-28 v, dc; 100/240 v, dc; 360 v, dc; variable voltage, 3 ph, 55-65 cycles.

In addition, any specialized voltage and frequency produced in any lab can be patched via the main patch panel in the power bay to any other lab. We patch outputs of precision tuning forks, radio frequency signals, pulse frequencies, and many others within the framework of modern electronics.

High-current feeds in labs designed for large equipment were led in through service switches and not through the patch panel. In this group were 28 v, dc; 208 v, 60 and 400 cycles. Where we figured a particular lab would have a heavy 28-v dc load, mg sets were installed under benches, thus holding voltage drop to a minimum.

Patch panel accommodates ac, dc and signal circuits. It connects main power bay with each lab. Some labs have their own sub-patch panels. As you remember from your college lab work, the patch-panel scheme is a two-way street. It takes the input from the power bay to any lab and vice versa. You might compare it to the nerve system of the human body with the brain (patch panel) as the central function.

Following a design worked up at Arma, three ac, three dc and four signal lines form the patch-panel feed. Compartments are sectionalized to keep ac and dc apart. Each line is fused at the output panel to protect lines and load. Fuse cartridges were so selected that a larger fuse cannot be installed—that is, larger than the patch-panel wiring size permits. However, smaller fuses can be used to protect any circuit under test.

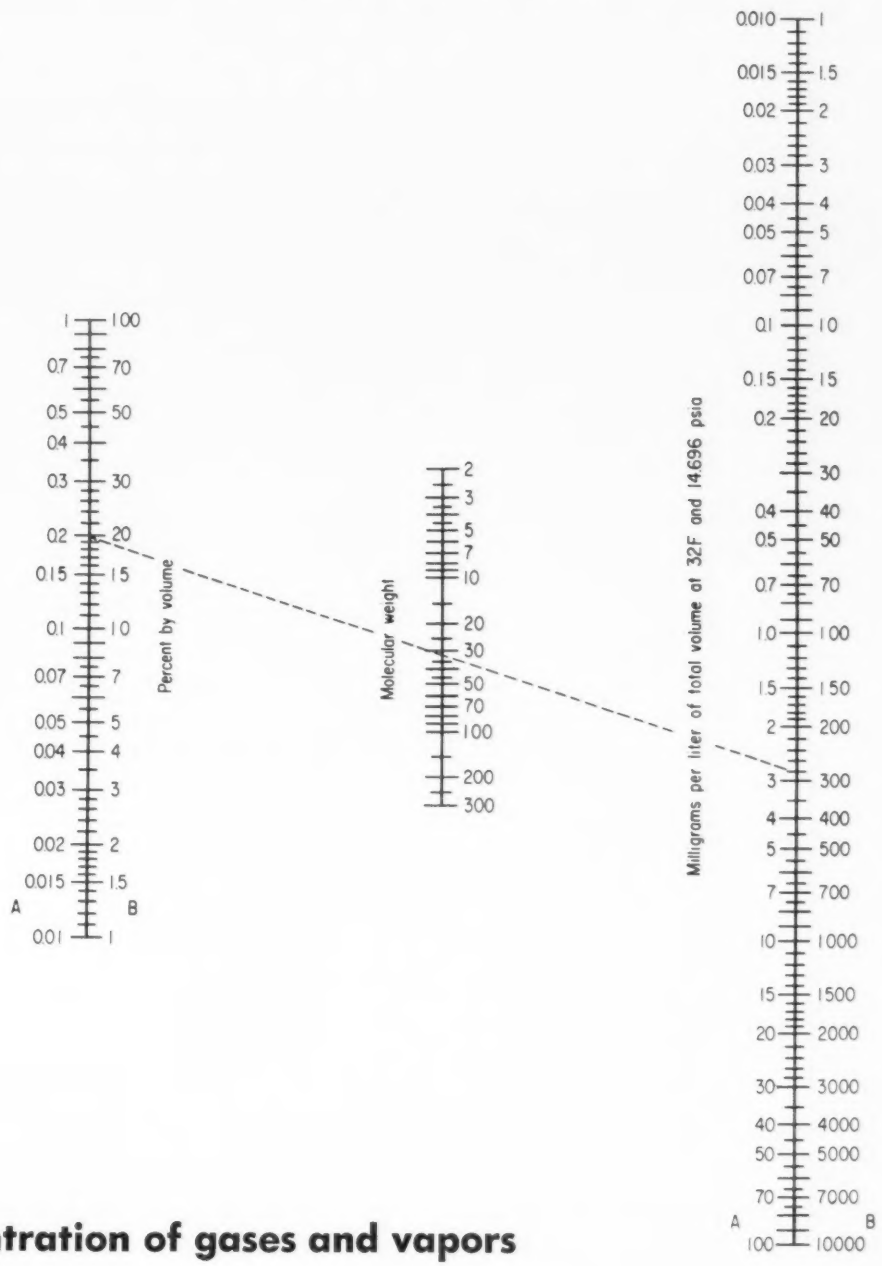
Five years of service for the distribution system have proved the basic design to be sound. The engineers who use it every day can attest to that. Furthermore, there have been no changes in the lab distribution scheme, although new equipment has been added to the power bay.

Power panel was flexible and expansible enough to permit adding several new mg sets, while the patch panel allowed new labs to be incorporated. The latter came about as a direct result of PTG planning. Inherent flexibility of a duct system was proved on several occasions. New patch-panel leads were easily fed to new labs in existing ducts.

This installation demonstrated to our satisfaction that an engineer must project his needs as imaginatively as possible to cover expansion and future development. Labs cannot be designed by economic appraisal of the present alone—at least a 10-year span must be considered. We found that a few thousand dollars spent at the start can have significant growth over ten years.

Power's data sheet

No. 312



Concentration of gases and vapors

This chart converts percent gas volume into weight concentration as milligrams per liter. One mole of gas weighs the same number of grams as its molecular weight M and occupies a volume of 22.4 liters. If we know the percentage that volume P occupies in a mixture, we can figure its concentration C at standard pressure and temperature by the formula:

$$C = MP/(22.4 \times 100) = 0.000446\,MP$$

Example: If a mixture of gases has 20% of O_2 as measured by an analyzer, find its concentration in mg per liter.

Solution: Find 20 on the B side of the left-hand volume scale and 32 (M) on the center molecular-weight scale. Connect these two points with a straight line and read 285 mg per liter on the B side of the right-hand scale.

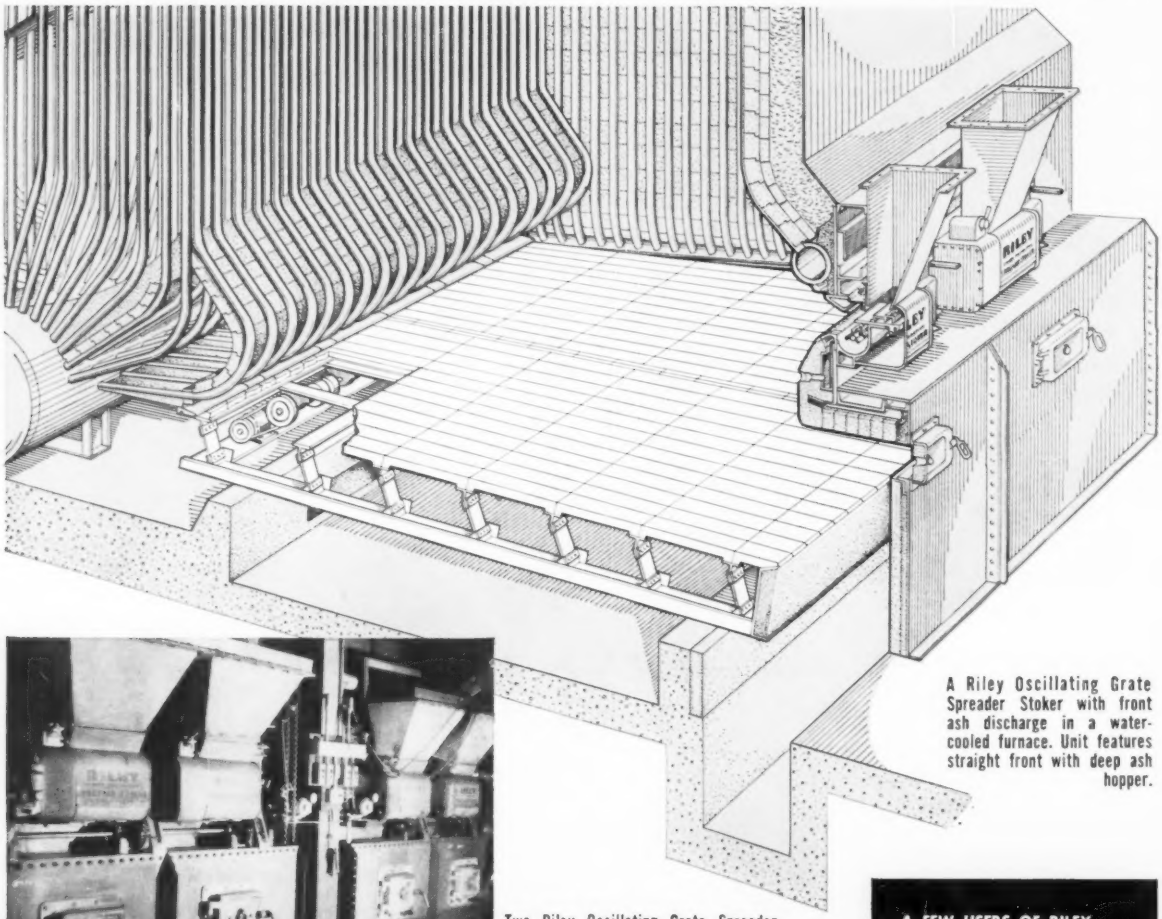
A sides of the outer scales should be used together only.

MARVIN H GREEN, *Philadelphia, Pa.*

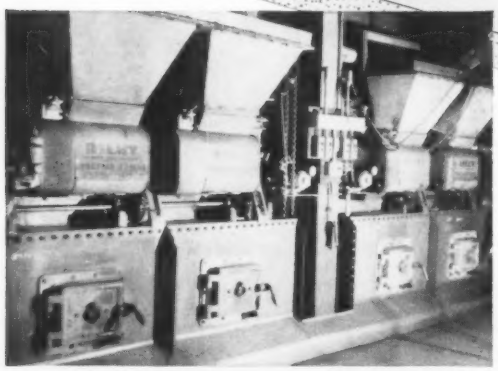
© POWER

The NEW Self-Cleaning RILEY OSCILLATING GRATE

Efficiently Burns A Wide Range of Coals
Under Boilers Having A Wide Range in Capacities



A Riley Oscillating Grate Spreader Stoker with front ash discharge in a water-cooled furnace. Unit features straight front with deep ash hopper.



Two Riley Oscillating Grate Spreader Stokers fire two 25,000 lbs per hour boiler units installed at prominent college located in western Massachusetts.

This Riley Oscillating Grate Spreader Stoker is installed under a 50,000 lbs per hour boiler unit at a southeastern Air Force Base.

A survey of your plant by a qualified consulting engineer could possibly show ways of making surprising savings in your power costs.

RILEY STOKER CORPORATION
WORCESTER, MASSACHUSETTS

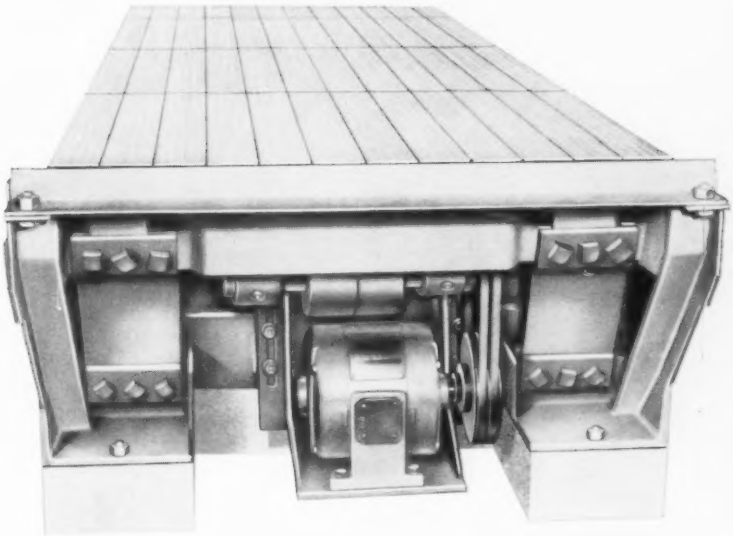
A FEW USERS OF RILEY OSCILLATING GRATE SPREADER STOKERS

St. Mary's Kraft Corp.
Elk Paper Mfg. Co.
Collins & Aikman Corp.
American Boxboard Co.
Mohawk Paper Mills
Chase Brass and Copper
Pittsburgh Plate Glass
E. I. duPont de Nemours
Andrews Air Force Base
U.S. Naval Air Station Brunswick, Me.
Clinchfield Coal Corp.

SPREADER STOKER

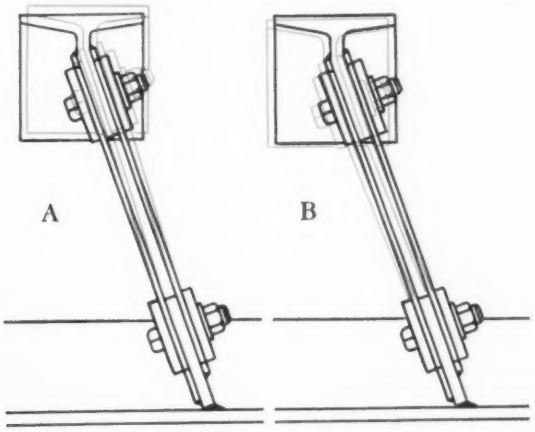
Adaptable To Any Furnace Depth and Width

Easily Installed At Low Cost For Either Front or Rear Ash Discharge.



Low Maintenance

The use of high heat-resistant alloys and adequate surface cooling gives long life to grate bars and seals. The only lubrication necessary is to the grate drive motor and to the feeders.



The amplitude of the flexure plates is exaggerated in this illustration to show positions of flexure plates when in high and forward position (A) and in the low and rear position (B). This amplitude of motion in actual oscillation of the grate is only about 1/8 of an inch.

Low Power Consumption

The oscillating drive mechanism employed with Riley Oscillating Grate Spreader Stokers is unusually simple in design and construction. One or more weights are eccentrically mounted on a single shaft supported by pillow block type bearings attached to the free moving cross-tee grid. The oscillating drive mechanism is belt driven by fractional horse power electric motor at approximately 1200 RPM. Oscillating motion of the slightly inclined grate surface moves the ash along the grate surface to the discharge end and into the ash pit. Depending upon the type of fuel and burning rates, the amplitude and frequency of oscillation is adjusted to discharge into the ash pit only ash and not burning fuel.

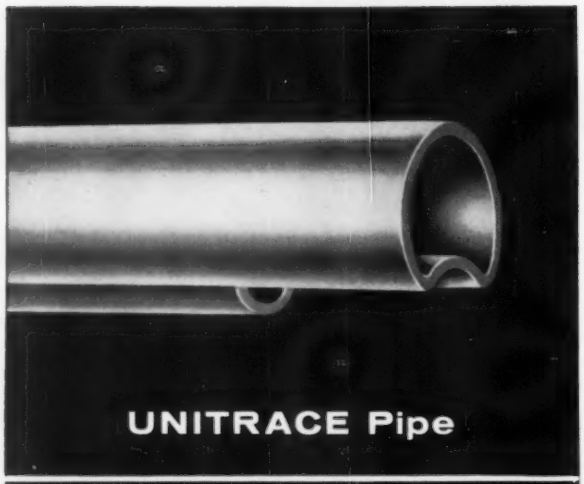
At full load oscillation of grate occurs at intervals of approximately 5 seconds every 10 minutes. Operation of the unit is governed by a timer control which determines the rate of fuel bed travel to suit load demands.

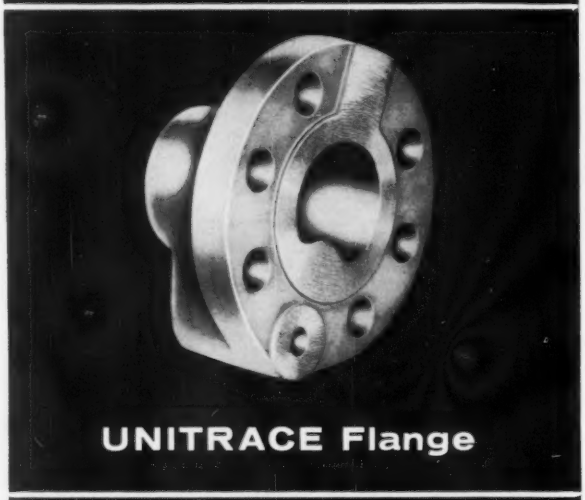
For complete details on this revolutionary stoker design contact a Riley Representative in any one of the following cities:

Chicago, Cincinnati, Cleveland, Detroit, Houston, Jacksonville, Kansas City, Los Angeles, New York, Philadelphia, New Orleans, Portland, St. Louis, St. Paul, Salt Lake City, San Francisco, Seattle, Syracuse.

RILEY

STEAM GENERATING & FUEL BURNING EQUIPMENT





Only **ALCOA** offers a complete new **UNITRACE** system

to cut costs and raise efficiency of steam-traced piping

Users of steam-traced pipe have found that valuable savings in cost plus greatly improved efficiency are automatic when they use ALCOA® UNITRACE. It provides steam and product passages extruded in a single unit of light, strong, corrosion-resistant aluminum alloy... completely eliminating the need for costly external steam jackets or inefficient tracer tubes. Now a new flange and trace cap provide fittings and connections designed for UNITRACE which are compatible with conventional piping. You can now design completely integrated UNITRACE piping systems and get all these benefits:

Low heat loss... high internal heat transfer
The recently introduced *round* configuration of UNITRACE makes possible most efficient internal heat transfer with minimum external radiation loss.

Easy, economical joints and connections
The special UNITRACE Flange mates with all 150-lb ASA flanged connections, permits use of standard flanged valves or other flanged connections. And the new UNITRACE Trace Cap permits quick, easy assembly of cross or tee connections.

Uses standard, preformed pipe insulation
The efficiency of UNITRACE often makes insulation unnecessary. When it *is* needed, standard preformed insulation can be used. UNITRACE saves extra dollars by employing smaller diameter insulation than conventional systems.

Excellent corrosion resistance
Thanks to the natural corrosion resistance of aluminum, UNITRACE is ideal for handling naval stores, molten sulfur, ammonium nitrate solutions, glacial acetic acid, fatty acids, tar, pitch, wax, urea, and similar products requiring heated transfer lines.

ALCOA UNITRACE and matching fittings are available in four standard pipe OD's: 1½", 2", 3" and 4". Get complete details on how you can use them to raise efficiency and lower cost on your own heated transfer lines. Call your nearest Alcoa sales office or write Aluminum Company of America, 888-H Alcoa Building, Pittsburgh 19, Pa.

Write for this FREE BOOKLET
This fully illustrated booklet contains complete engineering, specification and fabrication data on ALCOA UNITRACE. Write for your free copy!

ALCOA ALUMINUM
ALUMINUM COMPANY OF AMERICA

"ALCOA THEATRE"
Exciting Adventure
ALTERNATE MONDAY EVENINGS

Plant maintenance and management section

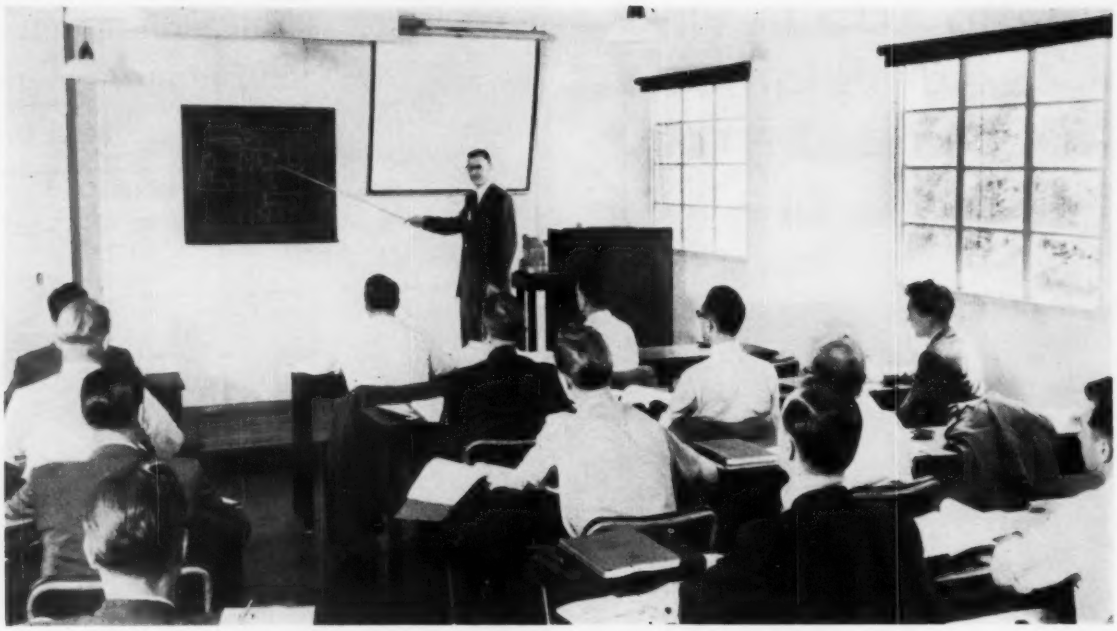
STEVE ELONKA
Associate Editor in Charge

First theory, then practice; pencils and screwdrivers are the tools of learning in . . .

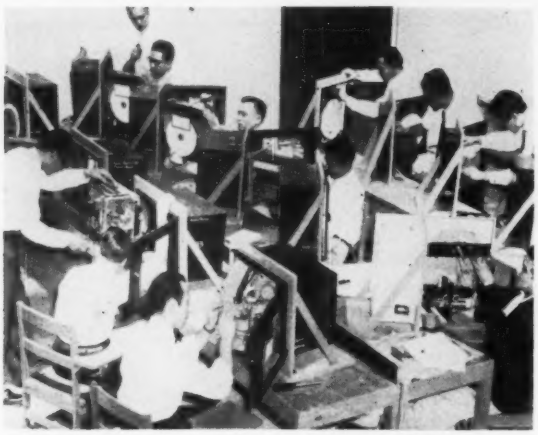
Control specialists' training school

"Teach 'em theory and practical features too" is the slogan of many industrial - control manufacturers' training schools, such as Minneapolis-Honeywell's center in Philadelphia. Both school management and instructors are convinced it's no longer enough for servicemen in plants to use the old turn-this-knob-and-see-what-happens approach for instrument repair and maintenance. Industrial control systems nowadays are too complicated for the untrained to comprehend; the instruments that do the work are advanced to the point where knowledge gained on-the-job just isn't reliable enough to insure sufficient control servicing.

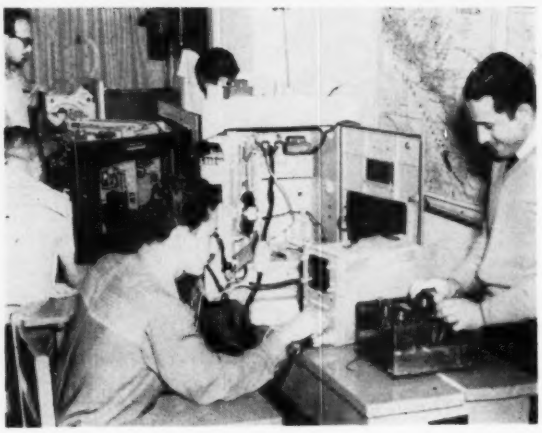
Shortage of qualified control specialists is a problem today, and it's been that way for over twenty years. Even that far back, control manu-



Before anything else, students learn *why* controls work . . .



. . . then they dismantle, reassemble . . .



and, finally, calibrate the instruments

facturers knew they were going to have their backs against a wall if they couldn't provide a steady stream of trained industrial-control specialists. At that time, there were no engineering colleges offering special courses in instrumentation, and trade schools didn't help, either. So control manufacturers decided to train their own men. This was the surest way of securing a needed service force.

First "school" set up by Honeywell for training their servicemen was opened in 1935 in Philadelphia. Since then, it has grown into a three-story building, with more than 5000 instrument technicians listed as graduates. In the past five years this training effort has gone abroad, with schools starting in London and Mexico City.

Instrument schools teach industrial students what even today is offered in only a few technical colleges—basic physics as it applies to process controls. Honeywell servicemen stay in school for fourteen weeks, and take a series of short courses, each involving a different type of instrument. The student uses a pencil for his first tool, as he studies the theoretical background related to a given instrument. Then he goes into the lab and, now using a screwdriver, puts into practice much of what he has just learned. It's in the lab that

By exam time, they have received the background needed to become specialists

he first takes apart, examines, then puts back together again and finally calibrates the instrument he is studying. When he has completed this cycle, an experienced instructor checks out the control, and if it isn't up to snuff, the technician-to-be starts all over again . . . dismantle, reassemble, calibrate.

After he has the first control down pat, on he goes to the next, and so forth until he masters the repair and maintenance of all controls in the program, which includes pneumatic, electric and electronic types. The course must include all types because this man must know his business—thoroughly. As a finale, each student takes an exam giving him a chance to prove he's learned what's going on.

Customer personnel as well as company men can take this training course. Generally, the customer is in need of a serviceman knowing only a few instruments, rather than many. For this reason, shorter courses are offered. Tailored to the desires of each customer, they vary from two to six weeks in length. In this way a man may study only what is necessary and not have to take time learning about controls he won't find back in his own plant.

Modern, complex instrumentation rules out the guesswork approach

Training courses organized and financed by industry are hardly something new. Honeywell's schools are one example of many that have been set up by instrument manufacturers. Such schools either supplement or take the place of technical schools, whether trade or engineering. Often what is needed could be supplied by a trade school, but there just aren't enough to go around. In the instrument field there is no need to employ graduate engineers for repair and maintenance, but specific and detailed training *is* needed if this job is to be done well.

Controls now are often very complex, delicate, sensitive. And the future doesn't indicate any letup in the use of intricate control systems. So the problem of obtaining skilled men will continue, and probably get worse. Many plants now have enough instrumentation to need skilled men present, but are not large enough to use a full-time instrument mechanic. The percentage of plants in this predicament will increase as more automated processes are introduced into industry.

This is an area in which the manufacturers' schools fill a real need. For customer-training purposes classes are flexible, designed to teach only those courses the customer feels his man should get. Such procedures keep everyone's effort concentrated in the most efficient spot. Instead of having to spend many long weeks in learning, the man may pick up enough in a couple of weeks, through books and lab work, to keep his company's controls close to the straight and narrow.

Although this effort by instrument manufacturers is a limited thing and cannot satisfy all the training needs of industry, their principle of "train your own" is reaping good dividends in the form of qualified personnel.

By L E STEWART, Assistant Editor

BLAST VICTIM in Esso refinery drill gets first-aid treatment by member of nearby GM plant's crack rescue team. Seven neighboring plants sent help in the mutual-aid test

Planned disaster aid on an area basis saves lives and valuable plant equipment—can mean the difference between big loss and quick recovery. Compare your thinking with this outline and be sure to . . .

Include your neighbors in your

A loud explosion and a flash of flame cut through the normal calm of refinery operation. Black smoke billowed up from equipment which, minutes before, had been alive with maintenance men and process engineers. A normal inspection was cut short by disaster.

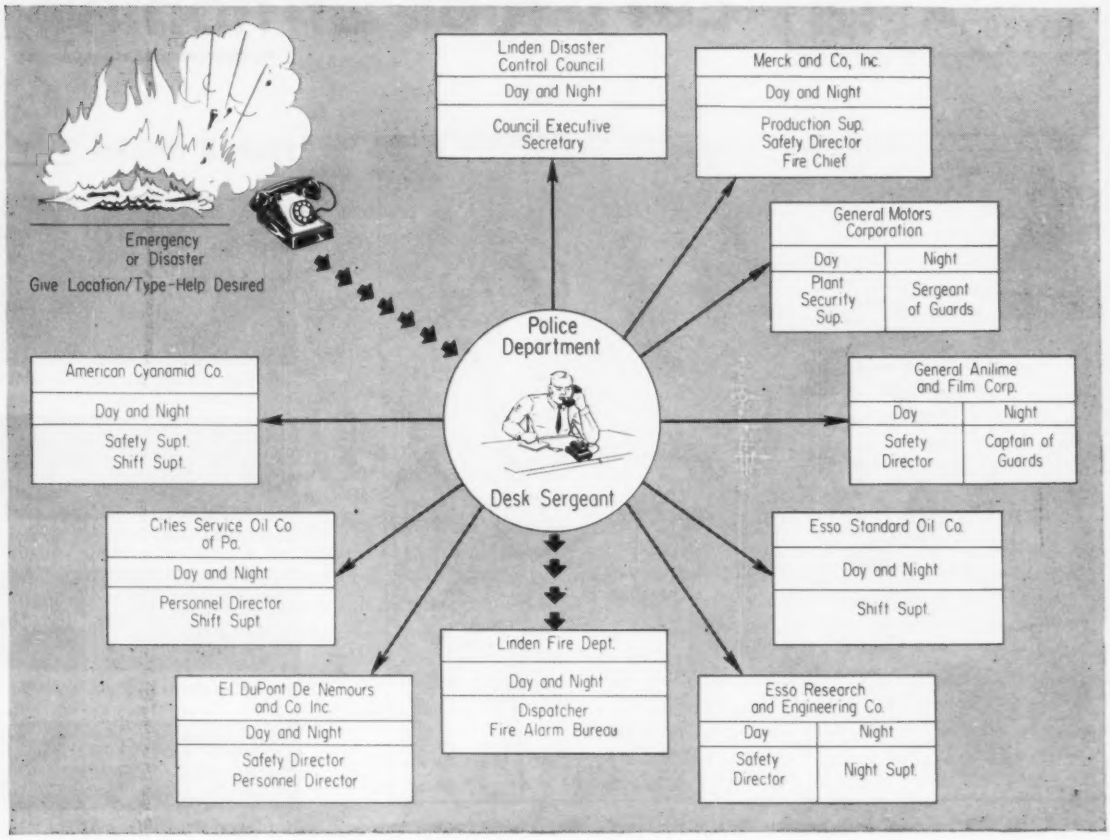
The refinery shift foreman was on the scene within minutes and knew he needed outside help. Several injured men were somewhere in the area, and more rescue and fire-fighting apparatus than the refinery owned would be needed. As an added hazard, a radioisotope used in examination of refinery equipment had been dislodged by the blast, turning the entire area into a dangerous "hot spot."

If this accident happened in your plant, would your disaster plans be adequate? In this plant the answer was "yes." Years of careful planning began to show up minutes later as disaster equipment poured into the area. A radiation-detection crew went into action to locate the missing isotope and clear safe paths to explosion victims. Simultaneously, rescue and fire-fighting teams from neighbors in the area's mutual-aid group pulled in. Crack rescue teams went to work and, in a short time, all victims were out of the disaster area and receiving medical treatment. The disaster plan ran like clockwork.

This could have been a tragic affair but was actually a realistic drill for members of Linden, N. J.'s Industrial Mutual Aid Council.

The disaster was a drill at the Esso Bayway Refinery in Linden. It included smoke bombs, "victims" and an actual isotope capsule. Rescue teams represented the eight companies and local police and fire departments that form the LIMAC group. LIMAC was host to a national convention of aid groups, civilian-defense officers and interested businessmen. As part of the 2-day convention, they demonstrated by the refinery drill the effective organization that has resulted from eight years of thorough planning and co-operation between member plants and local officials.

Eight plants have pooled available men and equipment into a detailed list. Calls for help are funneled



PLANT DISASTER in Linden, N. J. area sends mutual-aid members into action. Police desk is filter center for incoming calls. Emergency equipment is selected from master list and calls go out to member plants. Reserve units are kept for emergencies

disaster plans

through the local police desk and specific crews are sent in answer. This organized aid prevents stricken plants from being flooded with equipment they can't use. At the same time, other plants are not in danger of fighting someone else's blaze while the firehouse burns down. When the immediate danger is over and rehabilitation begins, preplanned pooling of repair facilities and spare parts can be used to cut days or weeks from plant downtime. Close co-operation of this sort is based on careful planning and attention to detail, beginning long before a crisis shows up.

The power-services man must be a key figure in this planning. Emergency measures and, later, repair and rehabilitation can be slowed down or stopped by a lack of power services. Our man will be in the thick of it after disaster strikes, with rescue and repair crews calling for electricity, water, air, heat, pumps, cutting torches, lifting rigs and plenty of rope.

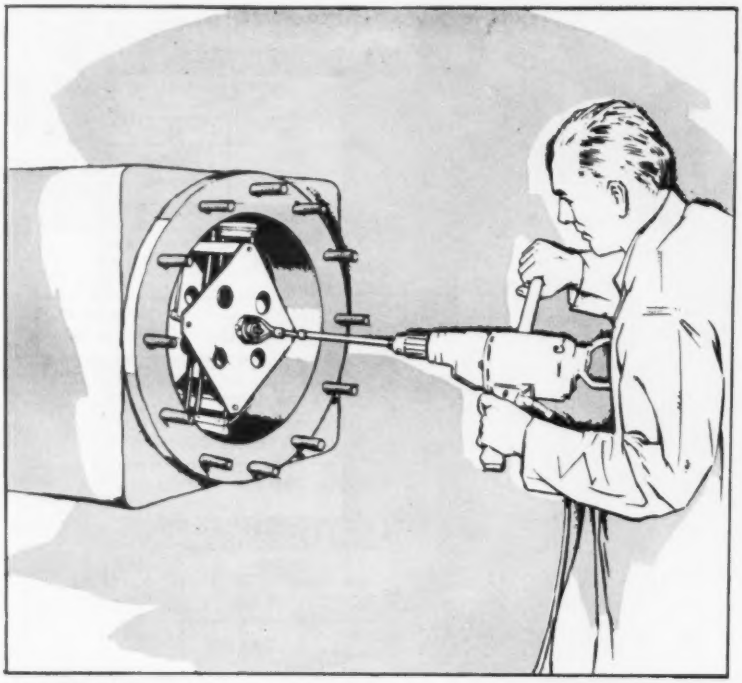
As an individual power-services man, you should plan *now* for emergencies in your plant. Management should assign priorities to areas and processes they feel are most essential. After that, it's up to you to plan for running temporary service lines to these points, or figure some way to disaster-proof key equipment. You should give some thought to how you would run lines if the main power-service supplies were still intact, and as a last-ditch stand decide how far you can afford to go with portable equipment. While planning for the day you hope will never come, find out from equipment manufacturers and local jobbers about replacement parts and repair facilities. And you may be pleasantly surprised by the detailed disaster plans major companies have ready.

When you have completed disaster plans in your plant, stop for a minute and think of the refinery drill. Imagine trying to handle a real explosion and fire without your neighbor's help—then plan to get this help through co-operation with major plants in your area. LIMAC or some other group can serve as a model, but the region's special requirements should mold your organization.

All the hard work is worthwhile, for it's your responsibility to deliver power services when and where needed by your company, and neighborly co-operation is one of the best types of insurance against serious loss.

OPERATORS' NOTEBOOK **121**

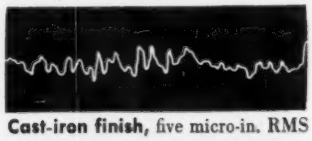
Let's look at honing,



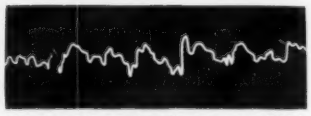
LARGE CYLINDER is honed with portable unit to remove fluted ring wear, scores, etc

Honed finishes

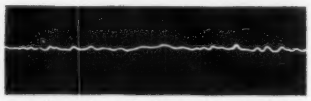
Cast-iron finish, 21 micro-in. RMS



Cast-iron finish, five micro-in. RMS

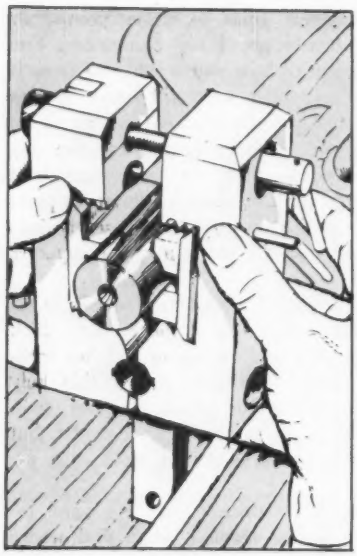


Hardened steel, eight micro-in. RMS

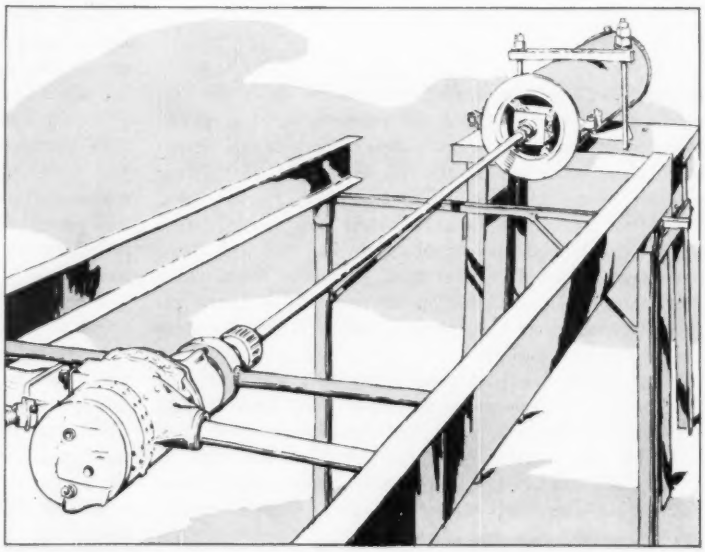


Hardened steel, three micro-in. RMS

Check below for other honing applications



EXTERNAL diameter honing tool gives perfectly round and straight finish



LONG CYLINDER is honed to fine finish with this long, heavy-duty tool. Being portable, tool is a natural for maintenance jobs, can be set up in a hurry

your latest maintenance tool

By STEVE ELONKA, Associate Editor

Here's what you should know about honing

Today, honing is solving many maintenance problems for the plant engineer. Honing does these things: (1) straightens cylinder walls to enable entry of full-size packings and piston rings (2) breaks glaze on old cylinder walls so new rings will seat quickly (3) refinishes turbine valve spindles (4) produces perfect alignment in tandem bores, such as bearings (5) corrects chucking, assembly and heat-treat distortion (6) gives surface finishes down to two microns.

Honing is a newer process than internal grinding and lapping, and entirely different, although all of these processes use abrasives. Grinding is done at high surface speeds, with high localized pressure due to relatively short line-contact between abrasive and work. Lapping uses a tool of soft material that can be charged with loose abrasive which forms a lapping compound to remove stock from the work.

High pressure of internal grinding can cause work deflection and heat checks. The uncontrolled abrasives in lapping cause washouts at ports, lands and at the ends of the hole.

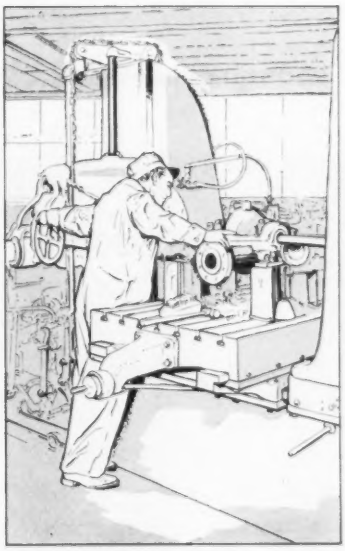
Honing is a low-surface-speed metal-shearing process. The stock is removed at the same instant by thousands of solidly held abrasive grains spaced over the full area of the rigid abrasive stone. Stonesare self-sharpening because the dull grains dislodge, allowing new sharp grains to take over. Because of the relatively large area and low pressure used in honing, this newer process eliminates heat checks, distortion, washouts and smear metal. It produces a cross-hatch base-metal finish with thousands of microscopic pockets, ideal for supporting a uniform lubrication film.

In honing, stock is removed first from all high spots in the hole, while low areas are bridged by the honing stone until the peaks are leveled off. Finishes are accurately controlled by the size of the grains in the stone.

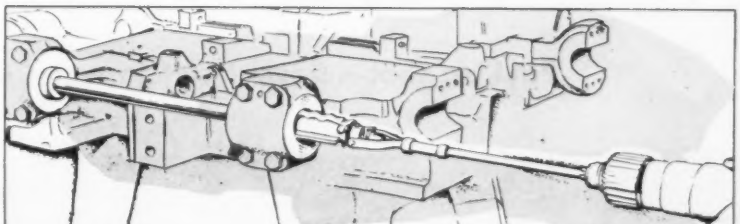
Today, honing is one of the major stock removal and finishing operations. Rate of stock removal varies with the material and size of work. For example, average figures for honing base metal in a hole ¾-in. diameter by 2½-in. long are: 0.0015-in. per minute in hardened tool steel (62 Rockwell), 0.004-in. per minute in SAE 1112 steel, 0.006-in. per minute in 17T aluminum, 0.010-in. per minute in bronze.

Honing prevents out-of-tolerance parts and rejects caused by hardening warpage, chucking distortion, boring bar chatter, reamer patterns and dull cutting tools.

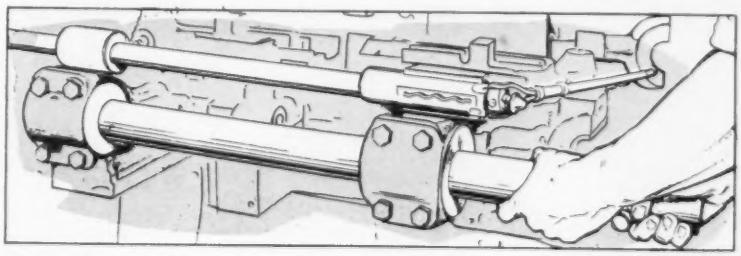
—*Courtesy, Sunnen Products Co, St. Louis 17, Mo.*



PUMP BEARINGS are honed in line in this large horizontal boring mill



ALIGN-HONING of bearings is simple and less expensive than doing them any other way. Fitting time is reduced to one-eighth and commercial ground shafts can be used



TEST BAR used here to check size is only 0.001 in. smaller than the finished bores, but it slides freely into place. Hone just used is lying on journal box

By K C WIZEMAN, Garlock Packing Co

FLEXIBILITY and precise design are keys to the effectiveness of the metal seal

At one time fibrous packing was a standard for reciprocating compressors. But, today, it's taken a back seat to . . .

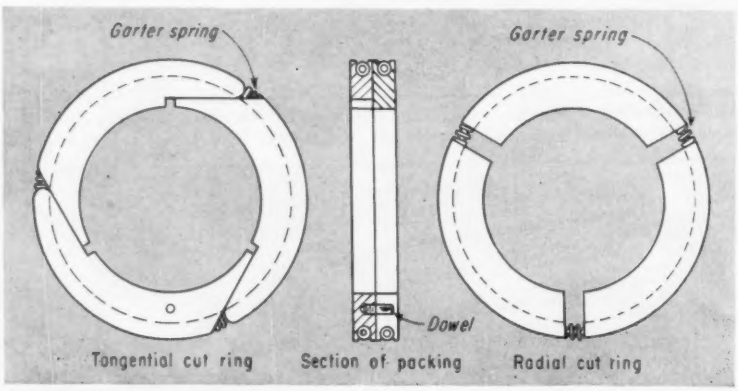
Metallic packing—best for gases

When it comes to selecting a packing for air compressors, or compressors in general for that matter, there's plenty of room for discussion.

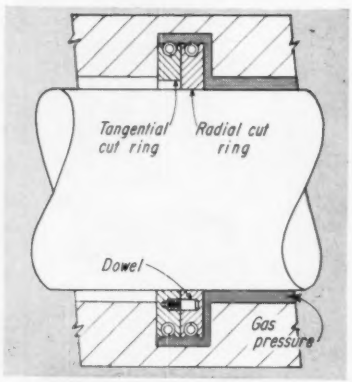
Fibrous, semimetallic, metallic—which will it be? Years ago the choice was strong for fibrous or semimetallic. You could get metallic, but there was an added cost. Today, the picture has changed. Metallic types are leading the pack, and being widely used as the original packing supplied by compressor manufacturers. Reason is simple: metallic is one of the best packings they've found for reciprocating-type gas compressors.

When looking for a packing, you've got lots to consider. What type of service is it for—intermittent or 'round the clock? How about heat and pressure? What gas is involved—air, Freon, ammonia? Can it do the job without damaging the shaft? Both the manufacturer and pur-

Packing that adjusts itself to wear and changing pressure . . .



TANGENTIALLY SLIT RING, *left,* does sealing. Slots in radial ring, *right,* fit over dowels, *center.* Radial-ring segments cover notches in seal ring and prevent leakage



SEAL RING is forced against both case and rod by pressure on cover ring and seal rim

chaser-operator have to think about these things before deciding on a packing.

Metallic packing is at the top of the popularity list because it just about stops maintenance costs while doing a good job. Granted, the initial cost per set is somewhat more for metallic types than fibrous or semimetallic. But when you compare a relatively maintenance-free service life of 8 to 10 years or more for metallic packing with the six months or a year of trouble-free operation you get from fibrous types, the initial cost becomes a small consideration.

Reciprocating compressors are best place to use metal packing. But it's not enough to pick packing materials for best pressure and temperature operation, you also have to consider the effect the gas will have on the packing metal. If the gas is highly corrosive, a fibrous or semimetallic type might be best, even though more trouble.

There's another good reason why metallic-type packings are good for compressor application. The way they're designed, as pressures go higher, the packing seats itself tighter and tighter about the rod. You don't have to tighten or loosen anything as pressures change in order to maintain a good seal. And the same thing is true as the packing wears. If you're using jam-type packings, periodic adjustments must be made in order to prevent leakage, but with metallic types, automatic self-adjustment compensates for the wear.

There are, however, important limitations on the sealing ability of these packings. For moderate-pressure service, say 200 to 250 psig, most packing manufacturers use a ground finish on the packing segment sides. Higher pressures usually necessitate using a lap finish. The sealing principle of metallic packing is simply clamping metal against metal, with only enough lubricant present to minimize friction, so the finishes have to be good or the gas will blow right past the mating surfaces of segments, case and rod.

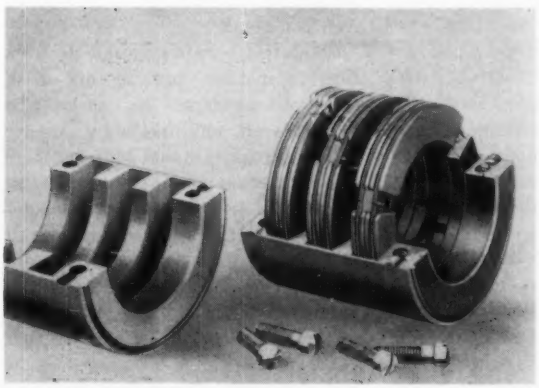
Installation of metal packings is relatively simple, yet you must do it with care to make sure the job is done right. First, check that there's no dirt in the case or cup joints, the segments and ring sides. Be certain the rod is smooth; free from burrs and in line. When packing is in place, see that the gasket is properly seated so you'll have a pressure-tight seal around the outside of the packing. To get the best service, break metallic packings in slowly, under partial load. If you start up under full load, there's danger that the segments won't seat themselves properly and you'll end up with leakage.

Lubrication of metallic packings minimizes friction, prolongs service life. In fact, if properly lubricated, these packings are almost cost free. Usually, if pressures are below 150 psig, enough lube oil for proper lubrication is transferred from the crankcase or cylinder to the packing by the plunger rod. You can easily check whether flow is sufficient by touching the rod with a white cloth during compressor operation. A trace of oil on the cloth shows there's a good supply of the lube getting to the packing. If working pressures are above 150 psig, install positive lube systems capable of pumping against cylinder peak loads. Best place to apply lube is close to the pressure seal. When lube drops on the rod here, it's carried outward, lubricating sealing segments in the rest of the case.

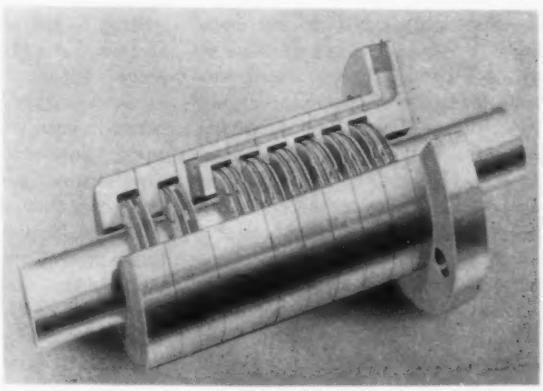
If pressures are really high, more than one lube line is needed. Quite often oils that are OK for cylinders aren't good for packing, so careful lubricant selection is important. For normal operation after wear-in, three to six drops per minute should suffice. Caution: too much is just as bad as too little. With too much, a pressure build-up on the packing ring occurs, producing leakage.

Packing material also directly affects service life. Don't use rings that'll score the rod, deform under pressure or corrode. If pressures are under 600 psig, and lubrication system is adequate, rings made of a graphitic-bearing-type cast iron should do the job. For higher pressures, a leaded bearing bronze is suitable. Nonlubricated service necessitates use of carbon for the segments,

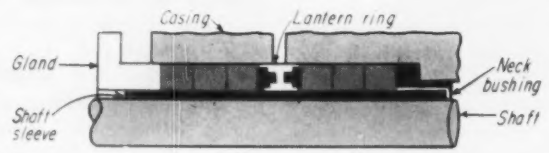
...that's what you get when you use free-floating metallics



SPLIT CASE is easiest to use. It allows installation without disturbing compressor equipment. Machining makes first cost high



SOLID CASE is best for pressures above 200 psig. This type is also used for l-p, since first cost is low and it does a good job



Stuffing-box details

Semimetallics are a good in-between

Semimetallic packing might be called a half-breed packing. It isn't all metal, and it isn't all fibrous. Usually semimetallics are made of strands of lead, babbitt, copper, aluminum, or even combinations of these materials, and then molded with binders and lubricants. This is a jam-type packing, and sealing is obtained by crushing the packing against the rod. For best results, make the gland finger tight, then adjust it as leakage occurs.

Installation of semimetallic packing is very critical, since slipshod work at this point will lead directly to short set life. At assembly, each ring must be seated properly in the box so it will be deformed by the gland. If the rings are not deformed, they sometimes slip about during operation, allowing particles to be broken off and carried through the equipment. Proper seating at installation also prevents the ring nearest the gland from being highly overloaded.

Lubrication plays a vital role in the packing's success. Up to 150 psig, most semimetallics will receive enough lubricant from crankcase or cylinder to serve their needs. Above 150, an auxiliary lube system is necessary, and oil is normally supplied to the packing through a lantern ring.

Although semimetallic packing has a much shorter life than the full-metallic type, it has certain advantages not found with the latter: depending on metal used, it's good up to about 2000 psig and 1500 F for reciprocating and rotating shafts, it's OK for liquids and fits places too small for metallics.

but the carbon grade selected is dependent on particular applications. For corrosive service, babbitt and phenolics are good. If rods are sensitive to wear, for example made of stainless steel or chrome plated, babbitt and carbon rings could be used.

Most metal packing today consists of two segmented rings. Each set is held together by a garter spring placed in a groove in the outside of the segments. These rings are then placed over the shaft in a back-to-back position. One ring is slit tangentially to the rod; the other is slit radially, and each ring serves a different purpose. Actual sealing is done by the tangential ring; as pressure is applied, segments are pushed against the case and slide over each other, gripping the rod tighter and tighter.

The radially-slit ring, known as the cover ring, keeps gases from getting to the seal ring. This is all it does, but without it the metal seal wouldn't work. Note in sketch, p 120, *right,* if cover ring wasn't there pressurized gas would blow through square slots next to the shaft. These slots change in size as wear occurs, and since they must be there, some means of keeping the gas from getting to them must be provided.

To insure that the slots are covered at all times, dowels are screwed into the middle of the tangential-ring segments. Cover ring is then placed so the radial slots are over these dowels, with the result that the cover ring can't change its position relative to the sealing ring. Only exception to the ring relationship is when sealing against a vacuum—in this case, two tangential sealing rings are doweled together and used in the same groove to provide a seal on each side of the groove.

When actually doing their job, metallic packing rings must be free to move in their cases. If they're installed so they bind against any part of the case, they can't change their gripping pressure as gas pressures change and wear occurs. That's why metallic packings are often called "free-floating" packings—they're free to move, or float around the rod.

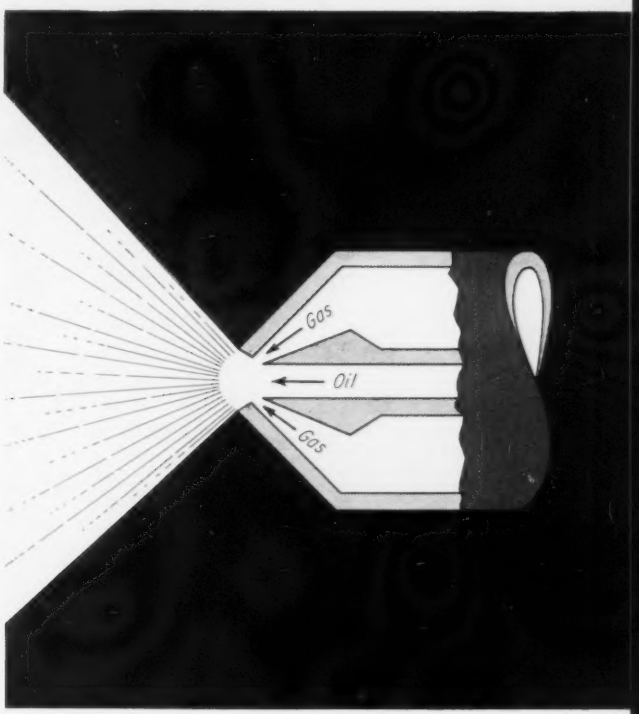
The number of packing sections (each pair of rings is a section) used for a given application will vary depending on the pressure controlled and gas used. Generally a minimum of three sections is recommended. Many packing suppliers use the rule that each section of rings halves the pressure. This is all right within limits. But if you have a high-pressure application, it would be better to use a few very precisely designed packings rather than just adding on many sets of what is basically low-pressure packing—this keeps down the length of the packing case. Some special metallic packings are used to seal up to 30,000 psi.

Split case housing design is generally used when pressures handled are moderate (200 psi). Maintenance troubles are reduced by use of this type of case, since the packing and case both can be applied without disrupting the equipment. If pressures are higher, best housing is solid, using cup-type packing housings. In this instance, packing fits within the cups and both are slipped over rod's end.

Metallic scraper rings in addition to metallic packing are used. They are segmented in construction like the seals, and the only difference is that the pressure that squeezes them against the rod comes from the garter spring and not from compressor-gas pressure. But if you use this type of scraper keep an eye on your oil-drainage system. Oil must be removed from the scraper housing fast enough to prevent flooding of the scraper rings. Many times oil losses can be traced to lack of sufficient drainage. Cast iron or bronze are generally the materials used for these scrapers.

How about atomizing oil with natural gas?

By V B THOMPSON. Ohio Fuel Gas Company, Columbia Gas System, Inc



OIL ATOMIZING BURNERS depend on velocity and expansion of air or steam for good mixing. Gas does job handily in this case

EDITOR'S NOTE: *Your most valuable characteristic as an experienced engineer is the ability to recognize the worth of a new idea and modify it to suit your special needs. This report presents a practical solution of a specialized problem outside of the power field. The solution was based on the low cost and year 'round availability of natural gas in the Midwest area, and the economics involved would have to be re-examined for any other area. Our challenge to you is to find some use for the basic idea in solving your power problem.*

Seven open-hearth furnaces at Empire-Reeves Steel Co's Mansfield, Ohio plant have been converted from steam-atomized to natural-gas-atomized oil firing. This has resulted in (1) reduced operating costs (2) increased production per furnace (3) an improved product and (4) a hotter flame for faster melt down of cold steel.

Following a plan worked out jointly by Empire-Reeves and the Ohio Fuel Gas Company, natural gas under high pressure (200 psig) is now used to atomize fuel oil as it is injected into the furnace combustion chamber. Gas-company lines could supply 200-psig gas directly to the burner so auxiliary gas compressors were not needed.

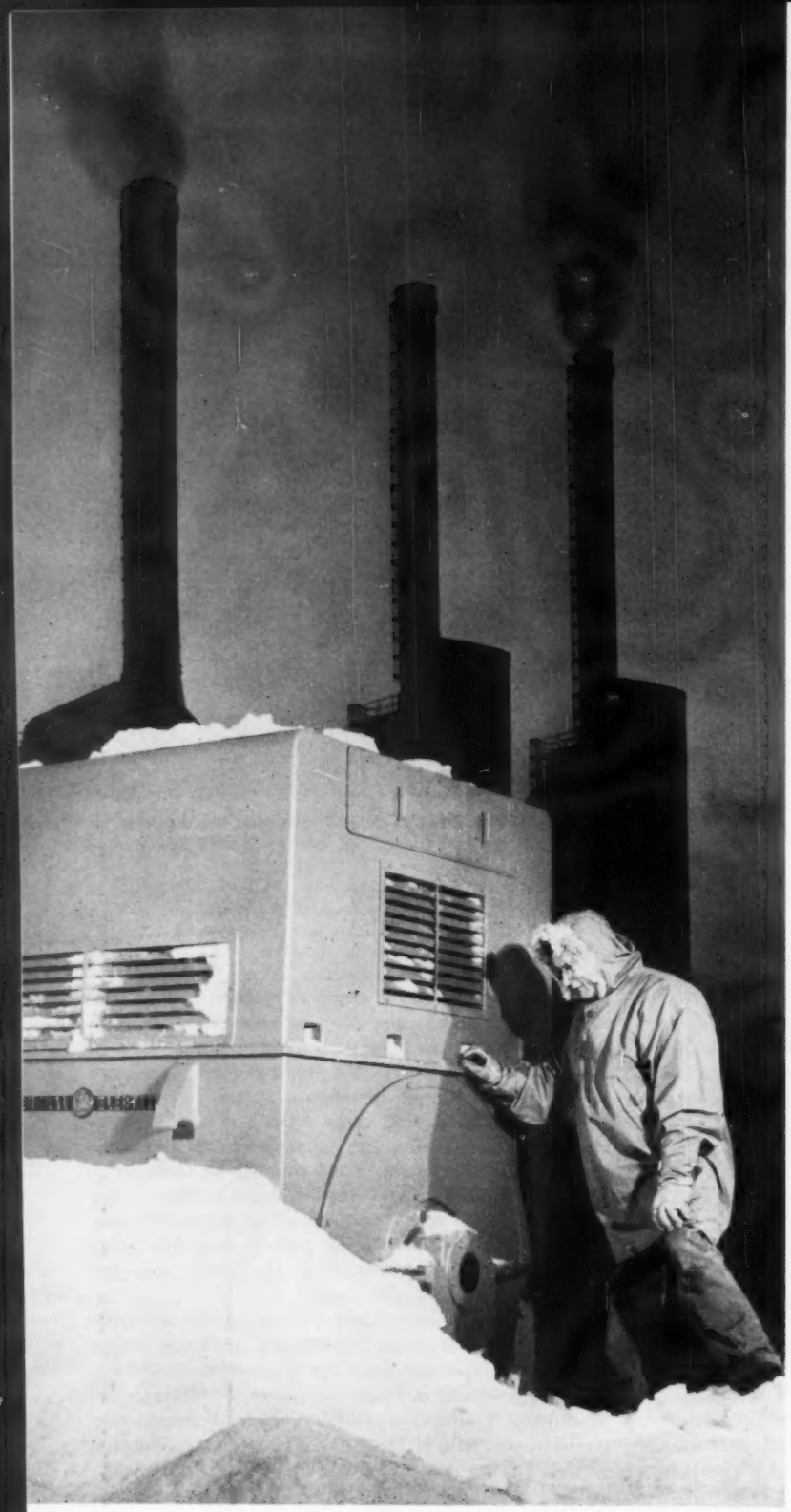
Before the conversion, the oil was atomized by the injection of high-pressure steam into the oil stream.

Operators tested the new method on one furnace. Results were so satisfactory that all seven furnaces were converted as soon as material could be secured. Cost of converting was so low that it was recovered in savings from the first month's operation.

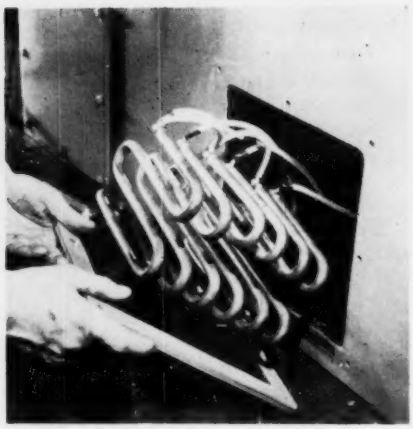
Biggest dollar saving came from replacing a large percentage of oil, with its higher price per Btu, with natural gas. This saving alone amounts to some 23%. The proportion of natural gas to oil during the melting period, when the heat input rate is highest, is 90% gas, 10% oil. During the refining period, when the firing rate is reduced by about 20%, the proportions are changed to 50% gas, 50% oil.

Substitution of natural gas with its exothermic reaction, for steam with its endothermic qualities, means greater heat input per hour and higher flame temperatures. This results in faster melting of the charge. The substitution produces a smaller volume of combustion products, per unit of fuel. The decrease in combustion products allows a greater fuel input rate with the existing draft making additional blower capacity unnecessary. Result has been an increase in production of about 0.5 tons per hour per furnace.

Also, with a substantial portion of the heat input now supplied by sulfur-free gas, the total sulfur content of the steel is reduced. Since reduction of sulfur is very desirable and difficult to obtain by other means, this is another important end result of the conversion.



DESIGN DIFFERENCES in the NEMA Type II weather-protected unit center about construction of the air ventilating paths. Aim is to prevent high-speed air and dirt particles from being carried into internal ventilating passages which lead directly to motor windings. This is done with baffling or separate housings which result in a minimum of three sharp changes in air direction. Also, an area of low air velocity is provided in intake-air path to further reduce possibility of moisture and dirt entering windings.



SPACE HEATERS are installed near frame bottom to prevent condensation on shutdown

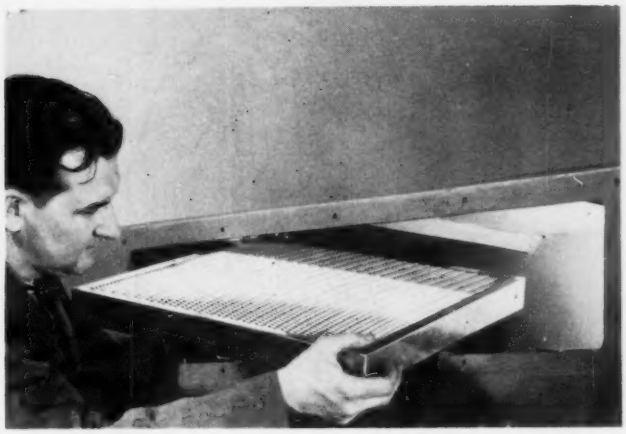
A newcomer:

One fact is basic to the discussion of motor enclosures: they are all either *open* or *totally enclosed*. And weather-protected motors are in the open category.

Original definition of a weather-protected motor, proposed by NEMA in May 1953, stated that ventilating passages should be designed to minimize entrance of rain, snow and air-borne particles to the active parts. Then, in July 1954, it was further recommended that the machine be guarded: air openings should be screened to prevent passage of a 3/4 in. rod.

But there were still some shortcomings—the definition failed to really provide for the many climatic conditions and applications found within the United States. So in June 1957, the NEMA membership approved definitions for two types of weather-protected enclosures. Type I is the original weather-protected definition while Type II spelled out three additional enclosure requirements. Here's the NEMA Type II definition:

A weather-protected machine-Type II *shall have, in addition to the enclosure defined for a weather-protected machine-Type* I, *its venti-*



AIR FILTERS trim maintenance costs by protecting motor's innards. Top section may be removed for complete inspection of air chambers

Here is a cost comparison

Weather-protected designs stepped into the enclosure picture some years back as power men moved toward installing motor-driven equipment outdoors.

The cost of weather-protected units runs anywhere from 15 to 40% above cost of dripproof enclosed motors in the 250- to 3000-hp range. A 1250-hp weather-protected motor costs about 20% more than a dripproof while a 2000-hp one runs about 15% higher. The smaller the motor, the greater the cost differential—at 250 hp the 40% figure holds.

With the new NEMA Type II weather-protected unit, you now have two available enclosures to suit a particular application.

NEMA Type II weather-protected motor

By PAUL L COCHRAN, Medium AC Motor & Generator Dept, General Electric Co

lating passages at both intake and discharge so arranged that high-velocity air and air-borne particles blown into the machine by storms or high winds can be discharged without entering the internal ventilating passages leading directly to the electric parts of the machine itself. The normal path of ventilating air which enters the electric parts of the machine shall be so arranged by baffling or separate housings as to provide at least three abrupt changes in direction, none of which shall be less than 90 deg. In addition, an area of low velocity not exceeding 600 fpm shall be provided in the intake air path to minimize the possibility of moisture or dirt being carried into the electric parts of the machine.

Having two weather-protected designs available means you can select the enclosure best suited for your particular application, conditions, and climate.

Looking back for a moment to the turn of the century when the electrical industry was in its infancy, we find that motor enclosures were relatively simple. Frames and end shields were open, offering minimum protection. Since the open machine was vulnerable to dripping condensate, splashing water from hoses during cleanup, splashing process liquids and tools dropped by accident, it became apparent that an enclosure-improvement was needed.

But it wasn't until August 1935 that NEMA formulated a definition for a dripproof enclosure. Then, in the same year, the splashproof enclosure was defined. These two, together with the totally enclosed forced-ventilated unit, made up the family of ambient breathing enclosures for large machines. In parallel with this, the totally enclosed fan-cooled and the totally enclosed air-water-cooled enclosures were developed for operation in contaminated and/or explosive atmospheres.

Then, immediately following World War II, the need cropped up for an ambient breathing motor for location outdoors which would fulfill application requirements at lower cost than a totally enclosed motor. At that time all plant expansion costs were rapidly increasing. So the use of ambient breathing motors outdoors offered one tangible method of meeting the cost challenge. Various systems of enclosures were offered, ranging from modified splashproof ones to those requiring that ventilating air make a succession of turns between air openings and active parts of the machine.

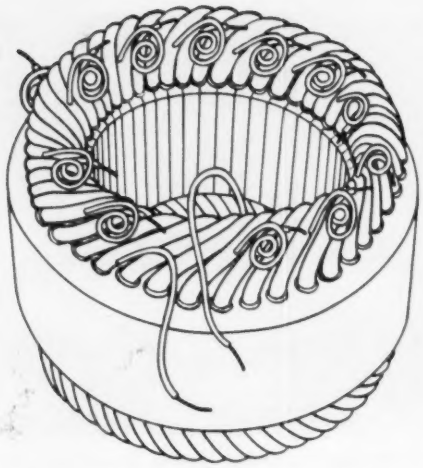
What's actually required of a weather-protected enclosure can be summarized: It must afford protection against normal rain, moisture-laden air driven by high winds, abrasive sand storms, and powdered snow driven by a blizzard. And the air passages must be designed to hold clogging to a minimum. Clogging might result from foreign materials such as corn husks, tumbleweeds, newspapers, etc. Naturally, the bearings must be protected from entrance of water and abrasive material while lubricating adequately under the different temperatures met. Windings must be protected against condensation of water vapor on shutdown. In addition to meeting all the above requirements, the machine must ventilate adequately.

Application of weather-protected designs is logical where an overall cost reduction can be had by investing a little more than the dripproof enclosure price—saving comes in field construction costs. There are other circumstances, naturally, which would justify specifying a weather-protected enclosure for a motor.

Plant

Electrical Fact File

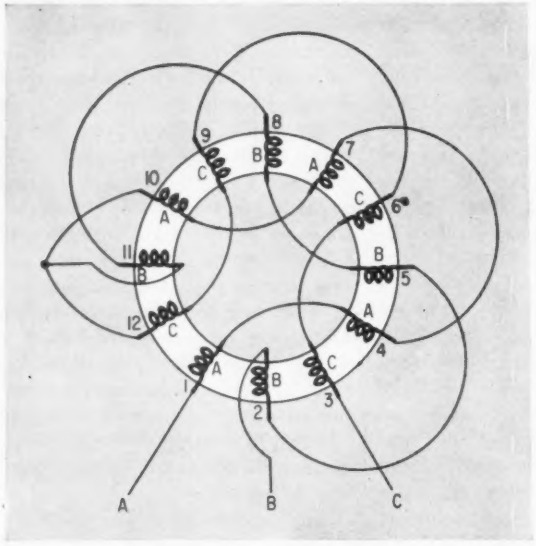
NO. 28: STATOR WINDINGS



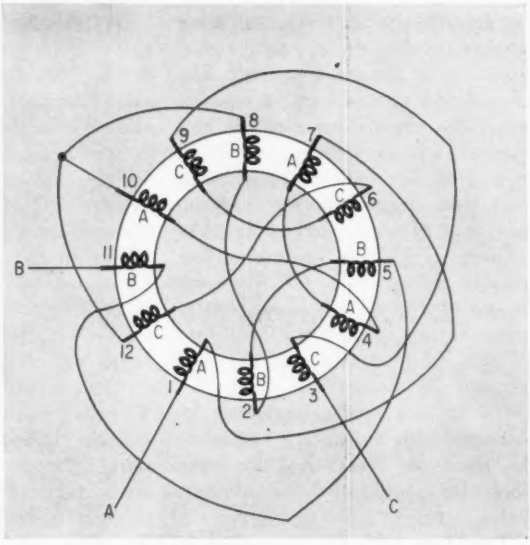
Stator windings of 3-phase induction motors are divided into groups of coils. Each group has a beginning (outside) lead and an ending (inside) lead. Number of groups equals three times the number of poles. Six common connections are given here; there are many others.

Six stator-winding connections

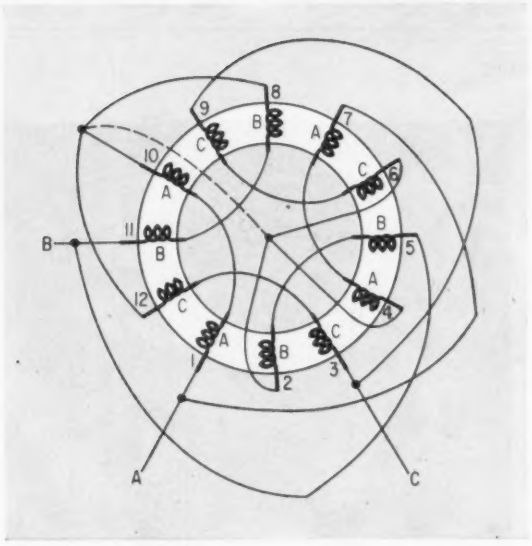
By NORMAN PEACH, Assistant Editor



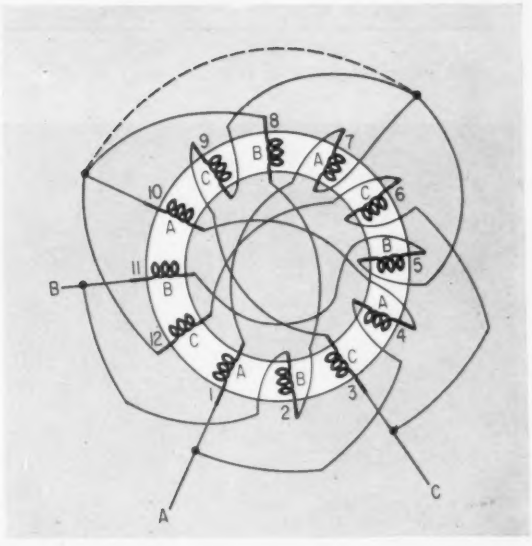
1 **SINGLE-CIRCUIT WYE** with *short jumpers* is the simplest connection. Groups are connected ending-to-ending and beginning-to-beginning. Remaining three coil leads form the wye. A 4-pole (1800-rpm) winding is shown. Note that phase *B* is reversed with respect to phase *A* and *C* by taking ending for *B* lead.



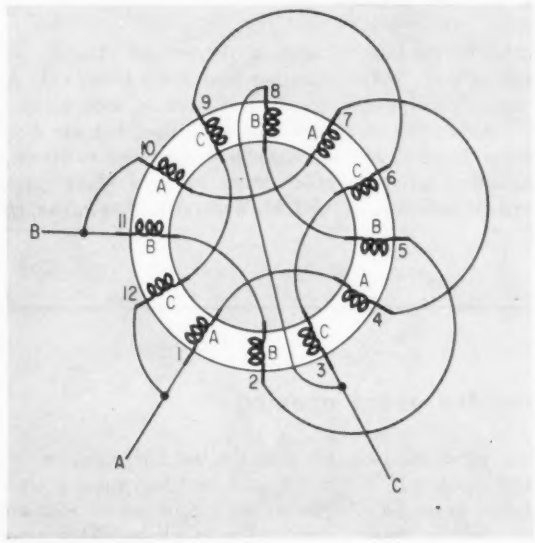
2 **SINGLE-CIRCUIT WYE** with *long jumpers* is sometimes used. Here ending of coil *1* is connected to beginning of coil *7*, skipping *A*-phase coil *4*. Ending of coil *7* is connected to ending of coil *4* by a *reversing jumper*. Polarity of adjacent coils is therefore opposite. This lead arrangement can be used with winding No. 1.



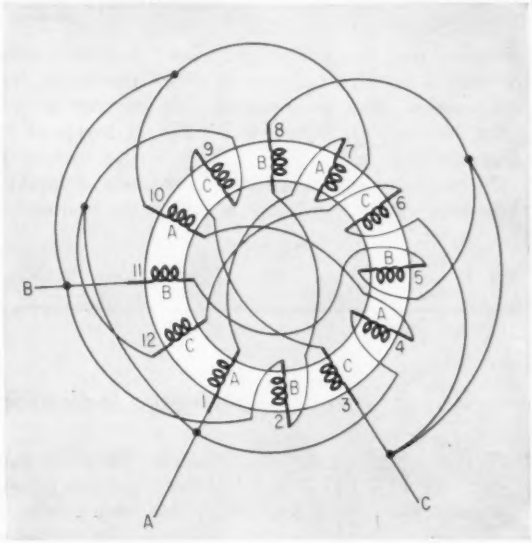
3 **TWO-CIRCUIT WYE** with short jumpers has beginnings of coils *1* and *7* connected together to form *A*-phase lead. Endings of groups are connected short jumper, for example, *7* to *4*. Two separate wyes can be formed, or all remaining leads can be joined together. Notice that *B* phase, as always, has reversed polarity.



4 **TWO-CIRCUIT WYE** with long jumpers is a popular connection. Lead for the *A* phase is formed by the beginning of coil *1* and the ending of coil *4*. Ending of coil *1* goes to beginning of coil *7*; beginning of coil *4* to ending of *10*. Wyes may be separate or joined. Winding is frequently adapted for dual-voltage service.

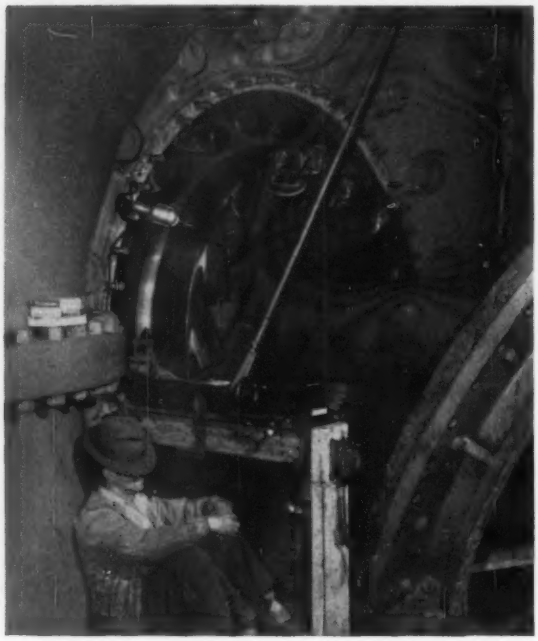


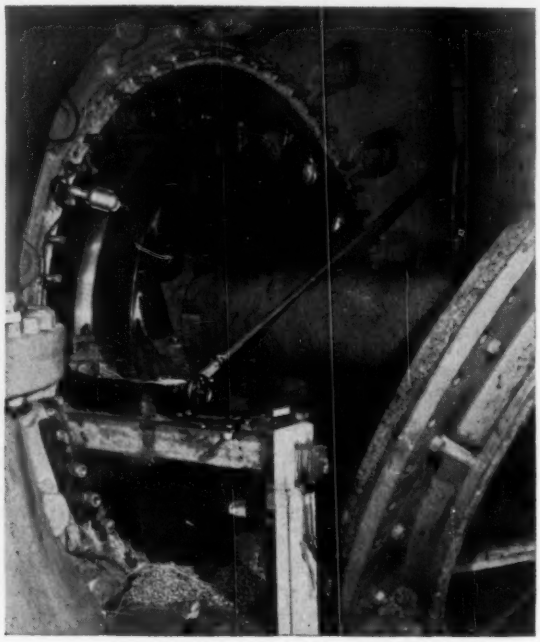
5 **SINGLE-CIRCUIT DELTA** with short jumpers is the simplest delta connection. Long jumpers are also in use. Polarity reversal of the *B* phase could be made as was done with winding No. 1. The delta leads are formed as shown using only beginnings of the groups. Generally, delta windings are not used below 10 hp.



6 **TWO-CIRCUIT DELTA** with long jumpers is preferred by some manufacturers for 10- to 200-hp sizes. Short jumpers are used also. Good procedure is to make up each phase, then connect into delta. Example: beginning of *1* to ending of *4*; ending of *1* to beginning of *7*; beginning of *4* to ending of *10*; *7* and *10* together, etc.

Timely **practical ideas** to help solve





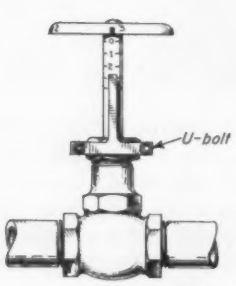
Here's your trick of the month

They say man became civilized when he started to think up ways to save his muscles. Most maintenance jobs offer these opportunities if we'll only take advantage of them.

These photos show how one of our ingenious men rigged up a lathe crossfeed with a ratchet to machine the band on a small runner. With ratchet on the feed screw, he slipped a length of pipe over the handle of the ratchet. A C-clamp fastened to one of the runner blades then notched the feed screw forward on each revolution of the runner. Results were smoother feed and a better cut. And the job was done in record time to boot. Not only that, but our bright mechanic had extra time to dream up other ways to save elbow grease.

L McWILLIAMS, *Shawinigan, Que.*

This valve indicator shows the exact opening



We often must set a valve in our process piping at part opening. To reset a valve in the future or to check on a setting, we calibrated the stems on these valves. Then, we attached an indicator to the packing nut with a U-bolt as shown. Next, we put circular lines on the stem and numbered them. Each line on the valve stem represents one turn of the handwheel.

First line should be up close to the wheel so the last line won't be down in the packing when valve is closed. These lines can be put on with a file or turned on in a lathe. When greater accuracy is desired, ¼-turn marks can be put on the edge of the handwheel. Valve shown is open 2¾ turns. This attachment can easily be built for most valves. One glance tells operator exact valve opening.

E JONES, *Bronx, N. Y.*

your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

What would you have done?

Some years ago a few of us gobs had liberty in a small port on the West Coast. Passing through the courthouse square, we saw a crowd watching some local talent erecting a statue of a native dignitary.

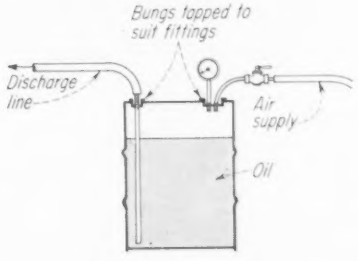
The workmen had rigged a set of shear poles with a rope sling at the top and a set of rope blocks suspended from the poles. All hands got on the line and hoisted the statue until the rig was "two blocked." But the statue lacked about a half inch of clearing the stone pedestal.

Not knowing what to do, they tied the line around a nearby tree. Then they held a caucus on how to get the statue to clear the pedestal without rerigging and starting from scratch. By then, there was a large crowd of sidewalk superintendents on hand, including a few dozen sailors from our ship.

Seeing that the workmen weren't even getting close to a solution, our well-oiled bosun's mate yelled, "Why don't you dumb lubbers throw a bucket of water on that manila?"

Everyone laughed, but one of the erecting crew decided our boy knew what he was talking about. So they turned a hose on the manila slings and went to lunch. So did we. When we returned an hour later, that wet rope had shrunk enough so the statue cleared the pedestal by a full half inch. What would *you* have done?

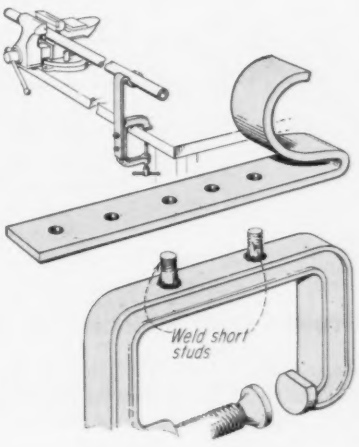
J B MURPHY, *Peoria, Ill.*



Easy way to empty oil drums

Transferring drums of lube oil by hand pump or bucket is a tough and messy job. Having two drums to transfer to a storage tank 8-ft high jarred my brain into action. After half an hour in the machine shop, I had completed the rig shown in sketch. Pressure gage is most important safety feature. If no gage, pressure over 5 psi will blow up the drum. So, keep an eye on that gage.

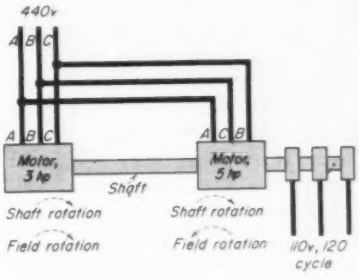
R HUNTER, *New Westminster, B. C.*



C-clamp with studs proves very useful

Welding a couple of small studs to the back of C-clamps makes them useful for supporting long work at the bench vise. Make the piece to suit the work. Use a 4- or 6-in. C-clamp to attach to the bench edge.

C H WILLEY, *Penacook, N. H.*

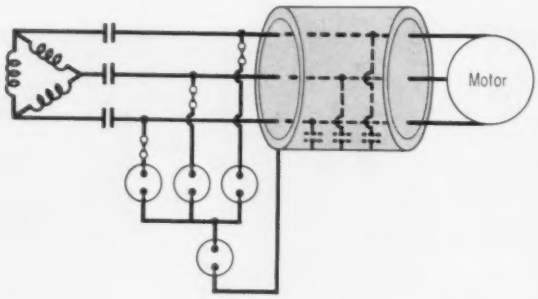


Increasing motor speed

We often have to increase speed of small motor fans, vibrators, etc. Frequency changer, above, was coupled together from spare 440-v motors. These were a 3-hp squirrel-cage and a 5-hp wound-rotor motor. From slip rings we had 110 v at 120 cycles, either 3-phase or single-phase. By transposing the two motor leads we tend to oppose the driven motor.

T E MOYER, *Longview, Wash.*

Turn page for more Practical Ideas ►



Ground fault indicator on balanced ungrounded circuit

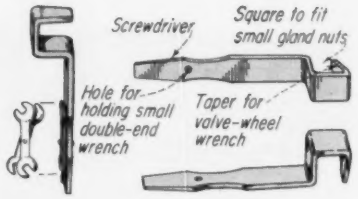
We installed a bore-hole pump in an oil-field well. This operated at 880 volts, 3 phase, and was supplied by an 11-kv overhead line and transformer, which had a mesh secondary, ungrounded. We were aware of the advantage of an ungrounded installation where the first fault on the system did not interrupt operations. But we wanted a method to warn us when the first fault occurred. It had to be simple so production people could see what was going on. The well was in a remote part of the field.

Searching through our store we found some 440-volt neon-tube potential indicators. These lit at around 110 volts and stood up to 1000 volts without apparent damage. They fitted nicely into porcelain 30-amp fuse bases. The finished indicator panel had an adaptable cast-iron adaptor box. Three fuse bases with neon tubes were arranged in a row, side by side, the fourth beneath, sketch.

Four holes were drilled in the cover opposite the tubes and a sheet of insulation placed inside. Top ends of the three tubes were connected by cartridge fuses to the three poles of the 880-volt supply. Bottom ends and top end of fourth tube were connected together, and bottom end of fourth tube was grounded. When operating under healthy conditions, the fourth tube remains dark, while the other three burn with equal brilliancy. If one phase goes down to ground, the fourth tube lights up and grounded phase burns dimmer.

The underlying principle is that the three top tubes and the core-to-sheath capacitances of the cable feeding the motor form a 3-phase bridge. The fourth tube acts as the detector.

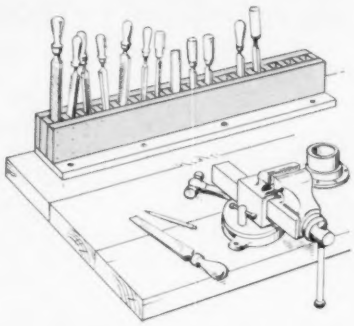
F HARDY, *Montreal, Que.*



Here's a 6-in-1 valve wrench you can make

By bending and shaping a piece of scrap metal as shown, a very handy tool can be made at little cost. U-shaped end takes on small gland nuts. Free end of U can be tapered for use as a valve-wheel wrench. Tapering long end on both sides and flats gives you a screwdriver. Another handy feature is a hole for attaching a small double-end wrench or wrench set. Stock can be 1 x 3/16 in.

C HALLORAN, *Toronto, Ont.*

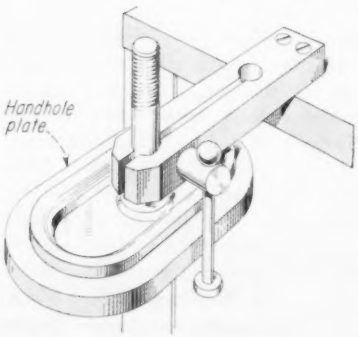


Handy file rack

A few pieces of wood made into a rack, sketch, and screwed to the back edge of your workbench will be a useful addition to your shop. The files are handy for instant selection. More important, they are well protected against dulling and abuse as when thrown into a drawer.

C H WILLEY, *Penacook, N. H.*

Handhole plate vise speeds boiler work



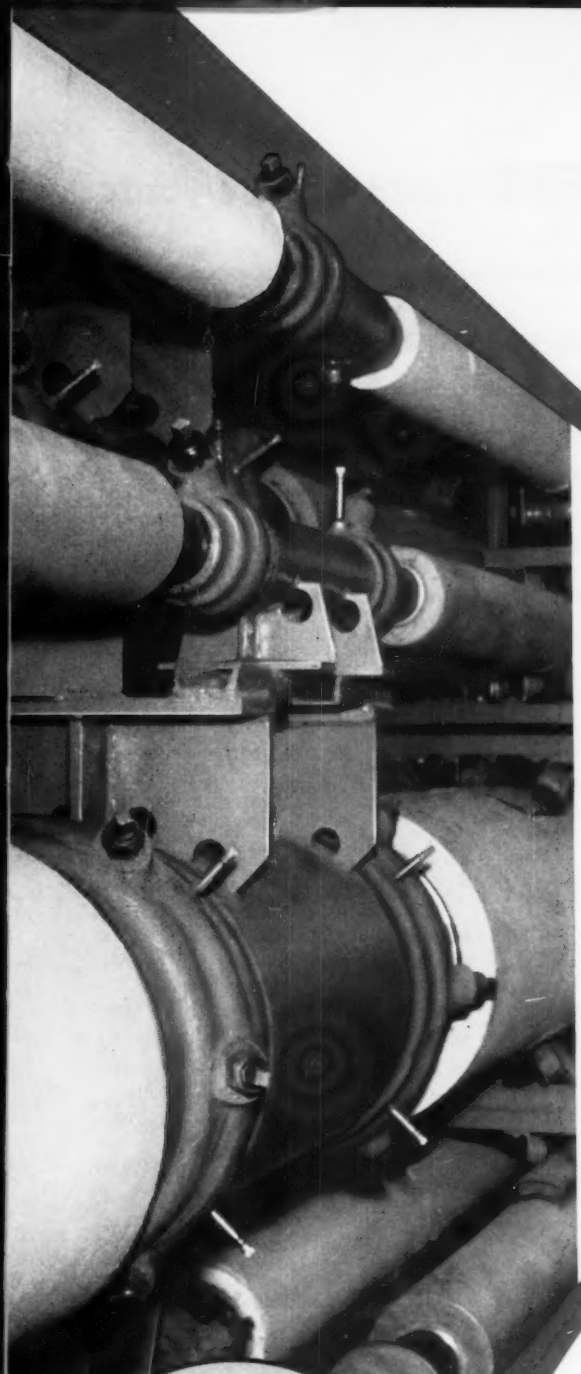
It's easy to rethread studs and clean gasket surfaces of boiler-tube handhole plates with special vise shown. Make one and you won't be able to get along without it after using a few times. Use good tool steel, machine it and then harden and temper.

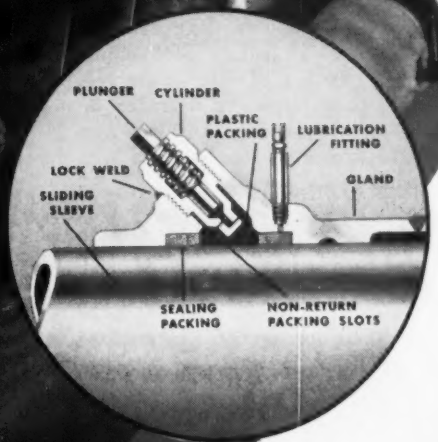
Because most boiler handhole plate studs are scaled, opening in vise should be large enough to have stud slide in easily. Spring action of vise will hold jaws apart until tightened.

H WILLEY, *Concord, N. H.*

My biggest boner

Please turn to page 174





Part of an installation of 37 new Yarway Gun-Pakt Expansion Joints at a Mid-West state institution

Details of new packing gun arrangement on Gun-Pakt Joints

something great has happened to steam lines..

..the improved

GUN-PAKT EXPANSION JOINT

With the many types of expansion joints available today for steam lines, it's important for engineers to "know their joints" when making a choice. Engineers know that Gun-Pakt maintenance costs have *always* been exceptionally low.

NOW . . . with the new Yarway Type W Gun-Pakt expansion joint you have these important *added* advantages—

CONVENIENCE—improved angle of packing guns makes them more accessible, thus reducing maintenance costs.

INCREASED STRENGTH—thanks to new one-piece integral body and gland.

LOWER MAINTENANCE—new packing gun design permits injection of special plastic packing *directly into packing space under full steam pressure. No need for costly shut-downs for repacking.*

Now is the time to find out more about Gun-Pakt joints. Write for Yarway Bulletin EJ-1916.

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
Branch Offices in Principal Cities

GO YARWAY WITH CONFIDENCE

These **plant problems** could well be yours...

The problem

How can we revive our sick wells?

I'm plant engineer for a medium-sized manufacturing outfit. Several years ago we put in an air-conditioning system and had to drill new wells for cooling and general plant service. Ground-water supply is adequate, but local regulations make it mandatory to return to the ground all water drawn from it.

Each well is about 150 ft deep, 12 in. across and at first delivered 600 gpm. Flow from all wells has slowly dropped and one well is now good for only 200 gpm. The disposal wells are in trouble, too, and can just about absorb the reduced overall discharge. Our plant can't afford to lose much more capacity. Can we boost flow and avoid the expense of drilling new wells? I'd like to know how other readers would tackle this problem.—*JT, May* POWER

The solutions

Look into this 3-step acid treatment

All ground water and for that matter, all useful water is supplied to the earth's surface by precipitation. Known as the universal solvent, water takes three routes after striking the ground: (1) runoff in streams and creeks (2) evaporation to the atmosphere (3) percolation through porous formations to become ground water.

Useful life and capacity of a well is fixed by: (1) water transmitting ability of ground formation (essentially particle size and distribution) (2) rate of percolation or recharge (3) physical character of well structure and (4) chemistry of available ground water.

Rainwater, falling to earth, dissolves CO_2 gas from the atmosphere. This produces slightly acid water which dissolves calcium, magnesium and sodium salts as it passes through the ground. Extent of pickup varies with temperature, pressure and amount of CO_2 in the underground water. If temperature or pressure changes, ability of water to hold these minerals in solution changes. Some of this mineral burden may then be deposited directly into the water bearing formation and onto the well screen. This reduces ability of formation to yield water and the screen's capacity to transmit water to the well pump. *JT's* symptoms strongly indicate well incrustation of this type.

First, analyze the water from each well for Fe, Mg, CO_2 and HCO_3 to get a good idea of its incrusting potential. Generally, acid treatment will restore capacity.

Engage a reliable drilling contractor and thoroughly discuss the problem with him. Use acid with extreme care and only on wells with corrosion-resistant screens.

Step 1. Remove pumping equipment. Slowly add inhibited 20° Be HCl to bottom of well through a 1-in. dia pipe. Amount should about equal volume of well screen. Surging the water column with drillers' tool string is a big help.

Step 2. Treat with H_2SO_4; the need for this step depends on age of well, total gallons pumped and water analysis for amount and type of dissolved solids.

Step 3. Pump the well absolutely clear and add glassy phosphates. Use between 15 and 30 lb of sodium hexametaphosphate for each 100 gal of water in the well. This does an excellent job of dispersing degraded incrustants and insures thorough cleaning. Any iron bacteria (crenothrix) in the formation can be killed with 1 to 2 lb of calcium hypochlorite per 100 gal.

After thorough surging, pump until water is clear. Then install an air line and altitude gage to measure well drawdown. Also, record total gallons pumped. These figures help avoid future capacity troubles.

Return wells can also be reworked with this same acid treatment. Budget figure for treatment in my area varies between $1400 and $2200.

M F LYONS, *Monaca, Pa.*

...Here's how *Power* readers would tackle them

ROBERT MARKS, Assistant Editor

It pays to study geology of the area

JT's wells are probably located in a more or less continuous rock formation. So water passage from either the surface or adjacent pockets and veins may be confined to widely distributed fissures.

Diminishing water yield can be caused by one or more of the following: (1) More water taken from underground pool than is returned. (2) Flow restrictions in existing fissures that prevent water from reaching the well screen even though enough water may be available in the general area. (3) Well screen plugging from debris, deposits or corrosion products. (4) Faulty pump operation.

For first two conditions only remedy is drilling new wells or sinking existing ones to a lower level. If well screen is plugged, blowing back with air or steam may be the answer. It may be necessary to resort to chemical cleaning. Be sure to pull and inspect the pumps for wear and possible plugging.

It definitely pays to investigate the geological formation. Enough information is usually available from your state's geological survey. POWER's special report *Worlds of Water*, Sept 1952, may also be of value.

M A JENSEN, *Lincoln, Neb.*

Cost of acid cleaning is moderate

We have a similar installation consisting of two 500-gpm supply wells and two diffusion wells. All are about 100-ft deep, gravel packed, and have 16-in. casings with a 10-in. drop pipe. Well screens are made of bronze.

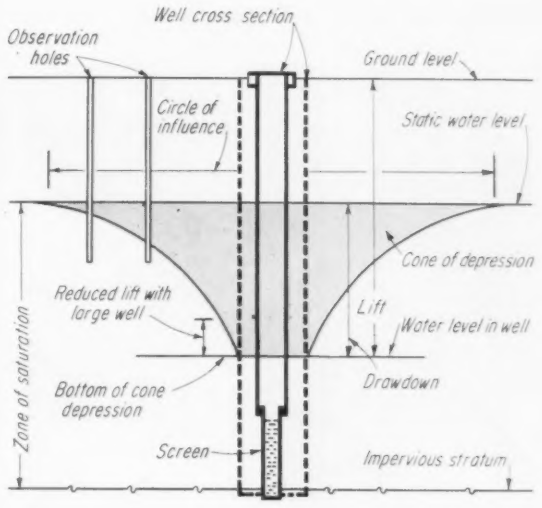
In my opinion you certainly can revive sick wells. We have just completed acid cleaning our diffusion wells and are very pleased with the results.

An outside concern specializing in this work was hired to do the job. They use a tank truck with pump and two experienced men. Treatment takes anywhere from 8 to 12 hours. Amount of acid and strength depends on volume of water in the well.

Cost of acid cleaning is quite moderate and is usually based on material needed plus time that men and equipment are on the job. Since the same crew and equipment can handle several wells, it's a good idea to treat as many as possible at the same time. Here's a rundown of costs:

1000 gallons of 28% HCl @ 45c per gal	$ 450
4 gallons of inhibitor @ $12 per gal	48
200 lb of wetting agent @ 41c per lb	82
1 industrial pump truck for 24 hr	118
Truck mileage—300 miles @ 41c per mile	120
1 engineer, 1 equipment operator for 8 hr	115
Total cost for acid cleaning	$ 933

W J STEINERT, *Fresh Meadows, N. Y.*



Here are five ways to restore capacity

Wells may be in confined (artesian) or unconfined water. Sketch, above, shows an unconfined or non-artesian well.

Since *JT's* withdrawal and recharge rates are down, flow area of well screens has probably been reduced by incrustations. Here are five ways to restore capacity: (1) *Acid treatment.* Use HCl alone or follow up with H_2SO_4. Both acids are needed for well sands with high organic or clayey content. (2) *Dry ice* can be used. Expanding CO gas is confined to well casing and must leave through the well screens. Cost is usually less than acid treatment. (3) *Compressed air* can be fed to casing to loosen accumulations on the screen. Works best with soft sludge-like deposits. (4) *Chlorination* is helpful when well screens are clogged with algae or crenothrix. (5) *Pounding* or *surging* with a heavy tight-fitting surge block produces shock waves to force impurities from screen.

H B WAYNE, *Woohaven, N. Y.*

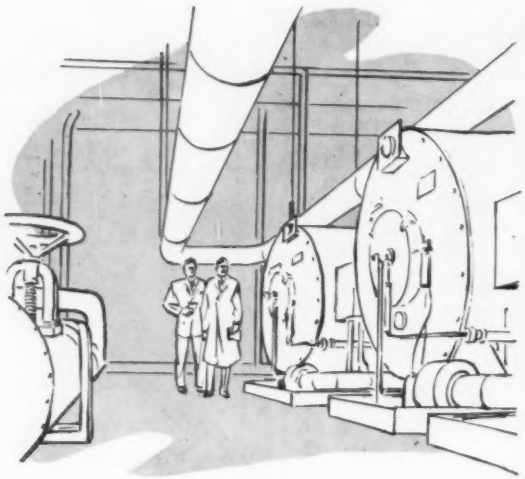
JT shouldn't overlook cooling towers

It's often possible to rebore a few feet through the existing well. After a thorough washing out of the well, new sands and stone can be slowly settled in place to restore filtration properties. Considering the expense of restoring well capacity, *JT* should think about using a cooling tower to reduce water consumption.

J W BISHOP, *Mineola, N. Y.*

Turn page for new problems ►

More **plant problems** Begins on page 132



The problem

What's best way to keep fuel lines and storage tanks sludge free?

Our plant includes three 35,000-lb-per-hr boilers and two 140,000 storage tanks containing No. 6 fuel oil. Suction line from each tank is 14 in. from bottom of the tank. Length of run from tank suction to fuel-oil preheater is about 100 ft.

Recently, plant operating efficiency has dropped about 9%. Can this be traced to sludge in the fuel oil? What's the best way to keep sludge out of lines and storage tanks? Are additives necessary? If so, how can we tell which type is best for our plant? What experience have others had in similar situations? I'd like suggestions.—*LPP, May* POWER

The solutions

Three steps to trouble-free operation

Here's how to keep sludge in your fuel oil system at a minimum: (1) Keep fuel oil temperature as constant as possible to minimize condensation caused by temperature changes. We use steam coils controlled by a temperature-actuated valve to keep our tank at 125 to 130 F. (2) Keep tanks as nearly full as possible, consistent with your schedule of fuel oil delivery. Less free space above oil level means less room for condensate formation. (3) Use a good fuel oil additive.

Most plants burning No. 6 fuel oil should use an additive. Burner efficiency depends at least partially on fuel oil quality with sludge and water causing poor combustion. Generally, the cost of additives is more than paid for by increased efficiency and reduced maintenance on fuel oil pumps, lines and heaters.

There are at least two main types of additives in present use. One is an emulsifier that breaks up any water present into small droplets and disperses them in the oil. The other causes the drops of water to coalesce and drop to the bottom of the tank below the suction line for periodic draining. *LPP* will have to decide on the best combination for his operation.

Vacuum gage on suction side of the fuel oil pump helps you tell when sludge is forming. If the line gets choked up with sludge, the pump will pull more vacuum. Reverse is true when sludge is removed.

Keep a close watch on fuel oil strainers if you are using additives for the first time. They will plug up quickly as the additive loosens up sludge already in the tank and lines. Best way is to clean out the entire system first, but this isn't always practical.

J M ELLIS, *Portland, Ore.*

Here's what additives did at our plant

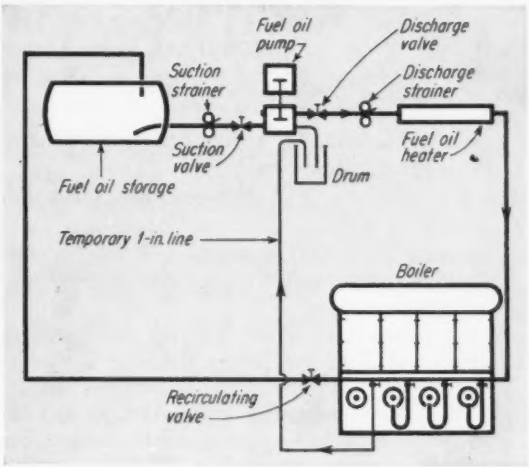
Our plant is considerably larger than yours and I envy the generous fuel oil storage you enjoy. But this can be a mixed blessing. Fuel tanks that keep you in business a month or more without refilling give sludge ample opportunity to settle out. So present hodgepodge of residual fuels now on the market can give trouble.

If you want to stir up a genuine rhubarb, ask any 20 engineers for their opinion of additives and expect 20 different answers varying from "superlative" to "plain useless." Truth apparently lies somewhere in between.

Some time ago, we tested an additive for a rather brief period and found that: (1) Boiler efficiency didn't change, at least by any measurable amount. (2) Fuel oil strainers remained spotlessly clean. Previously they always had a heavy coating of sludge. (3) Flame appeared a bit shorter and more brisk, bearing in mind the fallibility of visual observations. (4) Carbon on burner tips was soft and easy to remove. (5) Results can only be expected over a long period of use.

W J STEINERT, *Fresh Meadows, N. Y.*

Want some help on plant problems? Send us any of your design and operating headaches. We'll put *Power* readers to work on them



First, clean fuel system and storage tanks

Here's how we keep fuel oil lines and storage tanks sludge free. Sketch, above, shows our fuel oil system. First step is to clean the storage tank manually. Then, place a 55-gal drum, ¾ full of No. 2 oil, near suction side of fuel oil service pump. Run a 1-in. line from bottom of drum to suction side of pump. Run another temporary 1-in. line from last burner valve to top of the drum.

Close fuel suction and recirculating valves. Start the pump and recirculate No. 2 oil for about ½ hr at 130 F. Next, open the recirculating valve and empty the drum.

Pour 5 gal of fuel oil additive into the drum and mix with 30 gal of No. 2 oil. Recirculate this mixture for about 5 hr at 50 psi and 130 F. Inspect and clean strainers frequently.

We do this complete job about once a year. Our storage tanks are also treated before each filling. Another good practice is to introduce an additive either directly into the manifold of the fuel oil burner or just before the fuel oil heater.

J E MARE, *Brooklyn, N. Y.*

Look elsewhere for drop in efficiency

Boiler efficiency can drop for any number of reasons, but sludge and deposits isn't usually one of them. Sludge can bring real trouble by plugging up fuel lines, strainers and burner-gun orifices. Sludge itself isn't harmful if your oil suction line is higher than bottom of fuel oil storage tank. Experience and observation will help you judge how fast sludge is forming. When it reaches the suction line, call in a waste-fuel dealer to clean out the tank. In most cases there won't be any charge because of the potential value of the sludge.

P A DETHLOFF, *Chicago, Ill.*

Your August problems

What caused our feedwater nozzle to fail?

During an emergency overhaul to our No. 6 boiler, we found the feedwater pipe had collapsed for about one-half its length into the interior of the steam and water drum.

Rated capacity is 110,000 lb per hr at 720 psig and 735 F. Boiler has automatic combustion control with a two-element feedwater regulator. Feedwater pipe, above, is 6-in. OD with thirty 1¼-in. holes.

In the last two years the feedwater pipe has failed three times. First time there was a crack in the welding; second time it moved right off the support brackets. Before each failure it was hard to keep boiler-water concentrations down to desired level. But this time there wasn't any such indication.

What caused this pipe to collapse? Does the rise in boiler-water solids have any significance? How can we prevent another failure? Any suggestions from readers will be gratefully received.—*DM*

Do our centrifugal pumps need low-flow recirculating lines?

I'm responsible for the pumping equipment in a chemical process plant. We have a large number of centrifugal pumps in a variety of sizes, handling everything from corrosive chemicals to ordinary cooling water. Recent changes in our process now have some pumps running pretty close to shutoff for periods of several hours or more. I'm afraid we may be headed for trouble. Just how long can a centrifugal pump safely run at shutoff head with the discharge line closed? How far down can flow be throttled? Do we have to install low-flow recirculating lines? Have POWER readers had similar experiences?—*MH*

Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches.

Your page for comment

BOB BELLAS, Assistant Editor

There are such things

In telling how to keep a good man down and out, (*George Edwards*, May 1958) Professor S J Mason's ten rules certainly run the gamut of effective examination. George Edwards apparently told this story just for laughs. Surely there isn't anyone who could or would knowingly inflict such torture on any person who was trying to improve himself.

C G HOWARTER, *Canton, Ill.*

. . . a pat on the back for George for turning the spotlight on characters like this. I'd swear he was talking about a bloated-head that interviewed me following my application for a change in job classification. Shortly thereafter, I had another interview . . . with the personnel director of another company.

F X MCCHESNEY, *Chicago, Ill.*

. . . Prof Mason may have penned his rules in jesting fashion, but his hand also held the sharp rapier of truth.

T H PRICE, *Boston, Mass.*

Running in circles

In regard to your "better way" to divide a circle into five parts (*Practical Ideas*, June 1958, p 133), just who do you and your contributor think you're kidding?

D J MATHIAS, *St. Louis, Mo.*

. . . why parade such woeful ignorance of elementary geometry?

D H BOTTRILL, *New York, N. Y.*

Belt this one around

Referring to your chart on p 116 dealing with belting (*Operators' Notebook*, May 1958), what do you mean by "Basis: 10-in. diameter pulley?" Also, to what do these values refer: V- and flat-rubber 1.4, leather 2.2 and plastic core 1.0? They obviously can't be coefficients of friction. If you're talking about a relationship between tension of belt's tight side as opposed to loose side, these values are generally referred to as T1 and T2.

I checked your indicated source, *Mechanical Power Transmission Manual*, by W A Williams, and can't find anything in it that would correspond to these figures. How come?

W W MCKAIG, *Cumberland, Md.*

EDITOR'S NOTE: *We lateraled this one to Ken Tsunoda, of Extremultus, Inc, who says:*

. . . inasmuch as several different thicknesses or weights of V or flat belting could be used (depending on the pulley diameter and belt speed), a 10-in. diameter pulley was arbitrarily selected to put belt thickness into a specific range. The numbers ranging from 1.0 to 2.2 reflect typical service factors commonly used with belting. Again, these service factors were arbitrarily set for a typical application—a common reciprocating compressor with reasonably high peak loads and starting torque—as a basis for service factor selection for various types of belting.

The equation for the application of these service factors to leather belting is on p 135 of Mr Williams' book, and the actual service factors used are tabulated on p 134. The 2.2 figure, as you'll note, is just a typically reasonable combination of these leather-belt factors. Actually, with across-the-line starting of a squirrel-cage motor, the factor would more properly be 2.9.

Both flat rubber and V-belt service factors were taken as a reasonable summation of arc of contact and peak-load factors. The flat-rubber-belt ratings given on p 141 of Mr. Williams' book are to be applied against peak loads at 180-deg arc contact.

V-belt service factors are given on p 174. Here, compressor factors range from 1.2 to 1.4. These are normally multiplied by an additional factor of 1.2 for line-start motors. Other arc-of-contact correction factors are given on p 176. The 1.4 figure used in the chart was taken as a typical, average accumulation of these factors.

These factors are of major importance in making comparisons with plastic-core belting. The very high elasticity of the plastic-core belt, combined with the sizable margin between an ultimate strength of 28,500 psi and a design tension loading of 1560 psi, results in no need for service factors or, in other words, a service factor of 1.0 except under extreme conditions.

Example: Plastic-core belting is often used to start first dryer sections of paper machines having sleeve bearings. Here, the starting torque is about seven times the running torque. Under these conditions, no additional service factors are necessary for plastic-core belting.

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

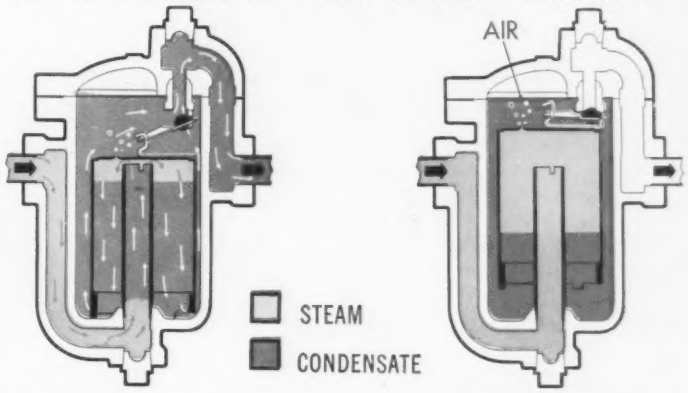
A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

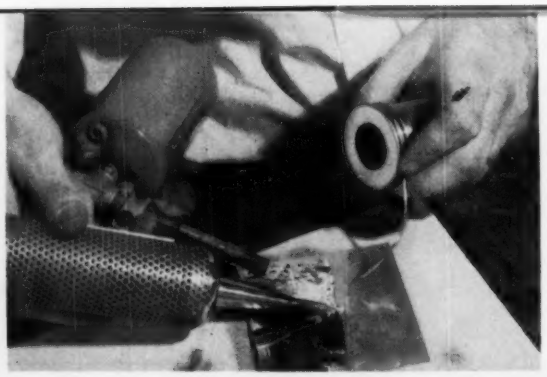
* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

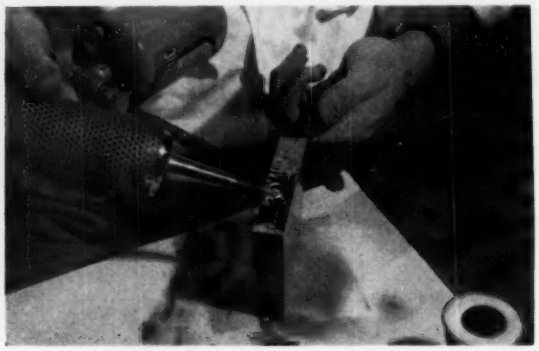
Armstrong Machine Works
8128 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

1 Turn on ultrasonic generator. Use either a gas-heated ultrasonic soldering iron (in hand) or an electrically heated unit



2 Tin the aluminum workpiece. Since cavitation removes the oxide coating, there's no need for flux or other preparation



3 Tin the second workpiece ultrasonically. When large areas are to be soldered together, tin each piece before joining

How to

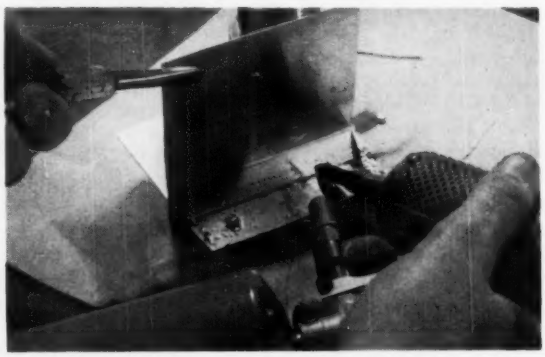
solder without flux

Now you can use an ultrasonic soldering iron to solder materials where the corrosive effects of flux are harmful. Aluminum, magnesium and their alloys are some of the materials in this group.

In operation, ultrasonic vibrations break the oxide layer of metals and alloys that form refractory oxides. Thus, these metals can be soldered effectively without any special surface pretreatment.

Additional applications include (1) surface tinning and filling blowholes in aluminum and magnesium castings (2) soldering light metal pipes or gutters that are not easily accessible for benchwork (3) assembly and installation of wave guides. Manufacturer claims that the technique used permits higher soldering-tip temperatures because of the minimum loss in transmitting heat from the transducer to the soldering tip. This instrument can be used with either electrically heated or gas-heated soldering tips.

—*Courtesy, Gulton Industries, Inc, Metuchen, N. J.*



4 Now, solder the two workpieces together, as shown above. For this job, use a hard solder having 91% tin and 9% zinc

5 Inspect the finished work. While neither heat nor ultrasound will solder aluminum, together they solder without using flux

JENKINS

O.S.&Y. U-BOLT GATE

MADE BETTER THAN NEED BE . . .

Costs Less to Use

YOU PAY NO MORE for the extra quality you see in every part of a Jenkins Outside Screw & Yoke U-Bolt Gate valve. Yet longer life and reduced maintenance is bound to result from the extra ruggedness, the precision manufacture and unique design features which Jenkins puts into these popular, general utility valves.

Choose the Outside Screw & Yoke pattern for services where spindle threads must be kept out of the destructive effects of fluids in the line; where spindle threads must be cleaned and lubricated regularly or where a rising spindle is needed to indicate wedge position.

Choose JENKINS, whether O.S. & Y. or Inside Screw pattern, for valves built to save maintenance dollars.

WIDE RANGE OF JENKINS U-BOLT GATES

GET FOLDER NO. 207 which describes Inside Screw and O.S. & Y. patterns . . . Iron Body with Bronze or Stainless Steel Mounting . . . All-Iron and Ni-Resist with type 316 Stainless Steel trim. Ask your local Jenkins Distributor or write Jenkins Bros., 100 Park Avenue, New York 17.

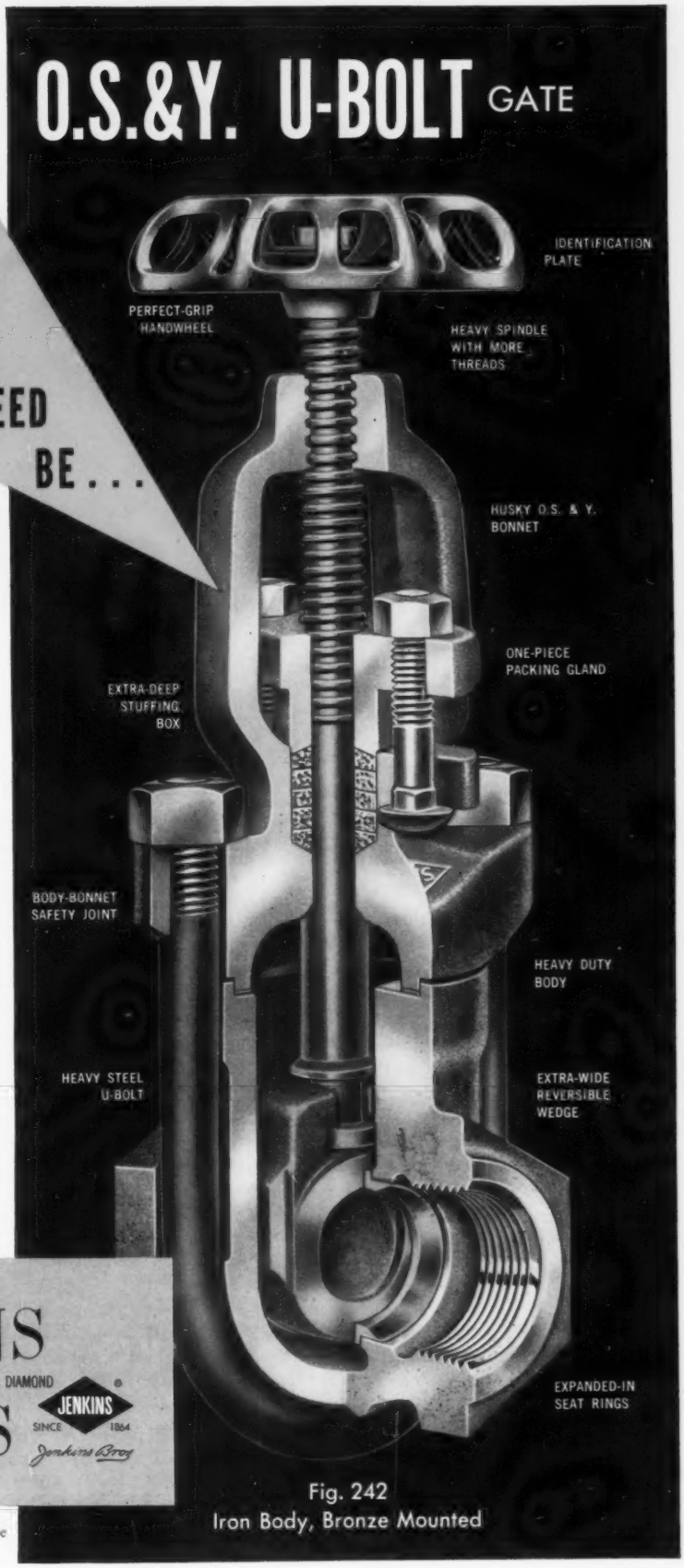
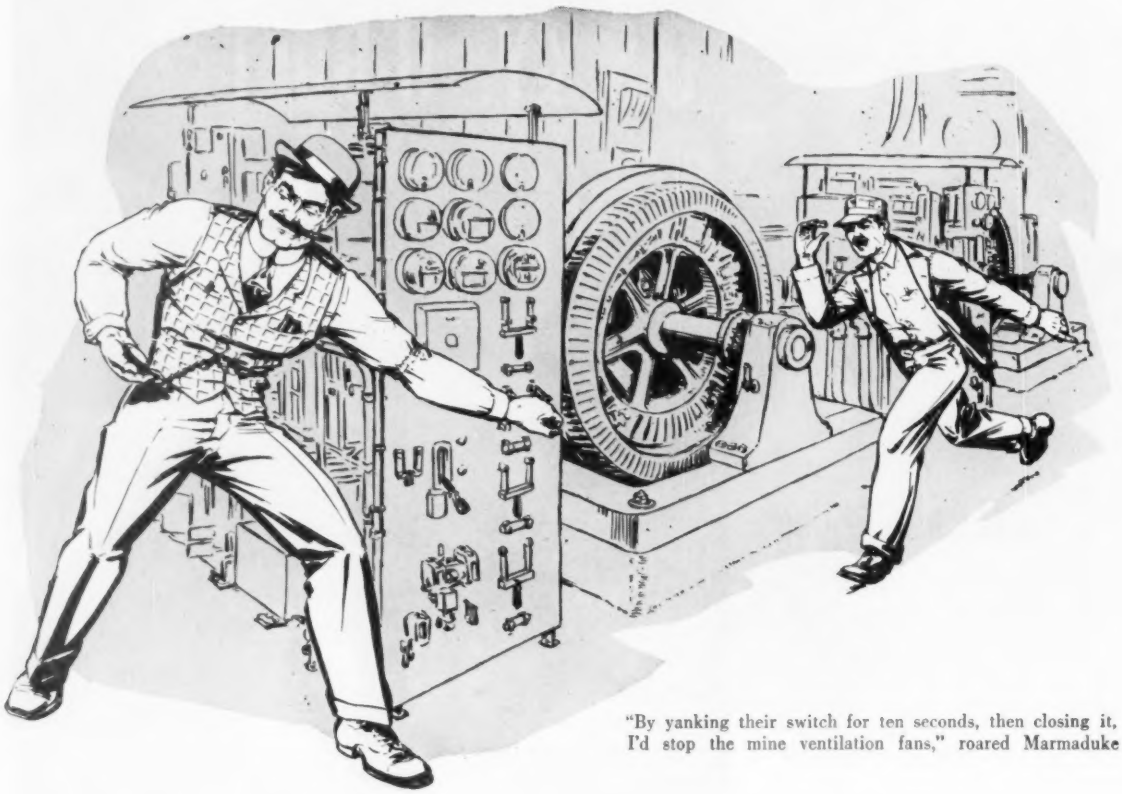


Fig. 242
Iron Body, Bronze Mounted

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
JENKINS
SINCE 1864
Jenkins Bros

Sold Through Leading Distributors Everywhere



"By yanking their switch for ten seconds, then closing it, I'd stop the mine ventilation fans," roared Marmaduke

Marmy tickles her ribs

Received a most interesting letter from my old friend, Don Brenton, who is with a new chemical plant. He writes, ". . . Compressing ethylene gas to 1500 atmospheres (22,350 psi) presents headaches that put all steam, electrical and mechanical problems I've known to shame . . . Times have really changed . . . Today it's alloy steels, precision fits, superfinishes, and original design and research for equipment and components . . . POWER helps us keep up to date. It's one of the most widely read technical journals coming to this plant. The routing slip includes physicists, chemists and top management. But I tear my hair because the copy usually reaches me with some choice articles clipped."

As I stuffed Don's letter into my pocket, I started wondering what Marmaduke Surfaceblow thought of all this new technology. A half hour later I was in front of Bedlam's Bent Propeller Bar along Manhattan's busy West Side waterfront to find out.

The place was so jammed it looked as if I'd need a shoehorn to get in. The babble of gravelly tongues and the loud guffaws was enough to split one's eardrums. But this was my lucky day, for I could see the old consulting engineer's gray bowler towering high above the other cash customers' noggins.

I pushed up to the crammed bar next to Marmy and ordered a beer. By way of starting a conversation, I mentioned something about 1500 atmospheres of pressure.

Marmy said nothing but straightened up to his full 6-ft 4-in. height, took a strangle hold on his bottle of Sandpaper Gin and sent a gullet washer below. Coming up for air he squared his shoulders and roared in his foghorn voice,

"BILGEWATER on 1500 atmospheres. I'll tell you would-be operators how we old-timers had to keep our plant running by coaxing more juice out of the equipment than it was rated for."

That did it. A second later you could hear yourself think again. All eyes focused on Marmy, as he slowly surveyed his audience, then blasted away at the top of his lungs.

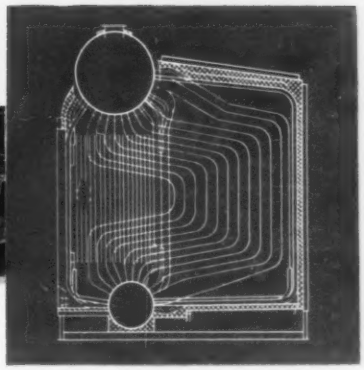
"Back in 1938 I was a shift engineer in a small steam power plant in central Alberta. We supplied juice to a large coal-mining district that included small towns and farms a hundred miles to the north. Two things made that job interesting: First, we were completely isolated. Second, we had no standby capacity. A new plant was going up, but that didn't help us that winter.

"Our plant had two Kidwell steam boilers with underfeed stokers, two old straight-tube B&W boilers with traveling-grate stokers and two old GE turbo-alternators. One alternator had a 2500-kw nameplate rating, the other only 1500 kw, which totaled up to 4000 (*Continued on page* 188)

HIGH CAPACITY PACKAGED STEAM GENERATORS

by Foster Wheeler

One of two AG-246 units, each capable of generating 50,000 lb/hr sold to C. F. Braun & Co. of Canada Ltd. for installation at the new Cities Service Oil Co. Ltd. at Trafalgar, Ontario



Series AG-200 extends economy and dependability of FW Packaged Design to over 60,000 lb/hr

To meet the needs of industrial plants for high-capacity Packaged Steam Generators, Foster Wheeler offers units for capacities of 50,000 to 63,000 lb/hr and higher, depending on operating conditions.

A modification of the proven AG-100 design which has provided industry with reliable, economical steam in the range of 10,000 to 50,000 lb/hr, these compact, space-saving units permit more steam capacity in less space than has heretofore been possible. For complete details, write to *Foster Wheeler Corporation, 666 Fifth Avenue, New York 19, N. Y.*

FEATURES:

Final Steam Temperatures to 840 F

Design Pressures to 900 psig

Standard Heat Recovery Arrangements Available

42-inch Steam Drum

Two Burners

Automatic Controls

Suitable For Indoor or Outdoor Installation

Tangent Bare Tube Furnace Side Walls and Roof

Staggered Boiler Bank Tube Arrangement

Fully Drainable and Removable Superheater.

THE FOLLOWING AG-200 UNITS ARE NOW IN PRODUCTION:

Capacity lb/hr	Operating Pressure psig	Final Steam Temperature Deg. F	Feedwater Temperature Deg. F	Fuel	Efficiency	Steam Quality
52,500	400	750	200	No. 6 Oil	85.5	3 ppm Solids Carryover
60,000	285	Sat.	220	Nat. Gas	78.3	3 ppm Solids Carryover
63,700	150	Sat.	225	No. 6 Oil	83.7	0.5% Moisture Carryover
68,000	620	Sat.	350	No. 6 Oil	80.9	1 ppm Solids Carryover

FOSTER WHEELER

NEW YORK • LONDON • PARIS • ST. CATHARINES, ONT.

Reports from the field

What's happening in power and what it means to you

Air-pollution control is good business

It's to industry's advantage to take the lead in fighting pollution, says William R Bradley, chief of the Industrial Hygiene Section of American Cyanamid Co.

In most cases, industry is not the chief culprit in the smog problem, but in a nation increasingly smog-conscious, it's good public relations as well as good community citizenship for industry to fight pollution without being urged.

It pays for both big and small companies to face up to a problem which can hardly be concealed. Sampling and study will show if pollution exists, and then control work and a well-planned public-relations program should begin at the same time. Finally, when the pollution is lessened, invite the public to admire the results—and let other companies in your field know about techniques you've found useful.

Also discussed at the recent Air Pollution Control Assn meeting was the tremendous job of preparing the Los Angeles public to accept air-pollution control. In L.A., described by the county's Air Pollution Control District as "one-hundred suburbs in search of a city," it was hard to organize a desmogging campaign because of the 61 corporate units, comprising six-million residents and 16,000 companies spread over 4083 sq mi. A giant, continuous public-relations program was started in press, radio and TV, with a policy of complete honesty. This has resulted in good industrial and public cooperation with necessary smog-control measures.

Personnel training is a major control step. Training course makes sure inspectors understand what equipment can cause pollution. Then they learn detection techniques and how to track pollution to its source.

(*More Reports on page* 192)

Power lines

Thermodynamic data for high temperatures and pressures will be compiled by National Bureau of Standards in a program supported by the Atomic Energy Commission.

Private generating capacity in the U.S. passed the 100-million-kw mark with the start-up of Tucson Gas, Electric Light & Power Co's 75,000-kw generator.

A unique recipe for removing boiler scale, recently found in patent-office files, calls for 250-lb potatoes, 175-lb cabbage, 75-lb carrots, 50-lb turnips, plus celery, caustic soda, kerosene and graphite. Mess is cooked for 12 hrs, then fed to boiler "as often as necessary".

We need more light, says the Illuminating Engineering Society. Their Blackwell Report indicates that a draftsman, for example, should have 200 footcandles of light—present average is 50 footcandles.

Venezuela is building an industrial complex—hydro plant, dam and steel mill—on the edge of the jungle, where Orinoco and Caroni rivers converge.

First prefab, all-aluminum substation took just six hours to raise and position after ground assembly.

"Do I have engineering aptitude" is a set of Q&A and interpretations available at $2.00 for 50 from Engineers' Council for Professional Development, 29 W 39th St, New York 18, N.Y.

Chances of present computers becoming obsolete within the next ten years are very slight, says J R Bradburn of Burroughs Corp . . . A computer designed to simulate an atomic reactor has been bought by U of Calif. with AEC's $42,100 gift.

For Calendar of Events turn to page 196

Russian automation facilities and techniques may pass U.S. by 1970 if we don't wake up, the ASME was told. And Soviets claim they will produce 500% more automation equipment by 1962.

Italy has installed an 8500-hp gas turbine in a Milan thermoelectric power station . . . High-speed turbine-engine ball-bearing lube is under study at Battelle Memorial Institute.

Beryllium may become a true wonder metal, ASME was told at a recent meeting. Its melting point is 2300 F, and it's more elastic than steel, stronger than titanium.

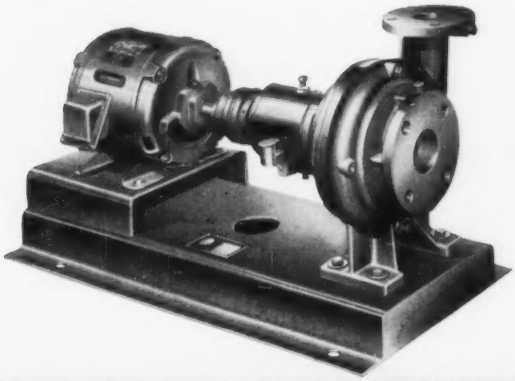
A 10½-mile tunnel will carry water from the Murrumbidgee River to the Eucumbene Reservoir in Australia's Snowy Mountains hydro development. Tunnel and a 150-ft-high dam will cost $14,500,000.

Sun batteries for satellites may find wide application on earth, the AIEE believes. Undergoing further development is use of solar converters to charge nickel-cadmium batteries.

Transit power plants in New York City just cannot be operated competitively by the city, states the Mayor's Report. Electricity costs as much as purchased power; costs will increase as plants become outdated. Conclusion: Sell the plants.

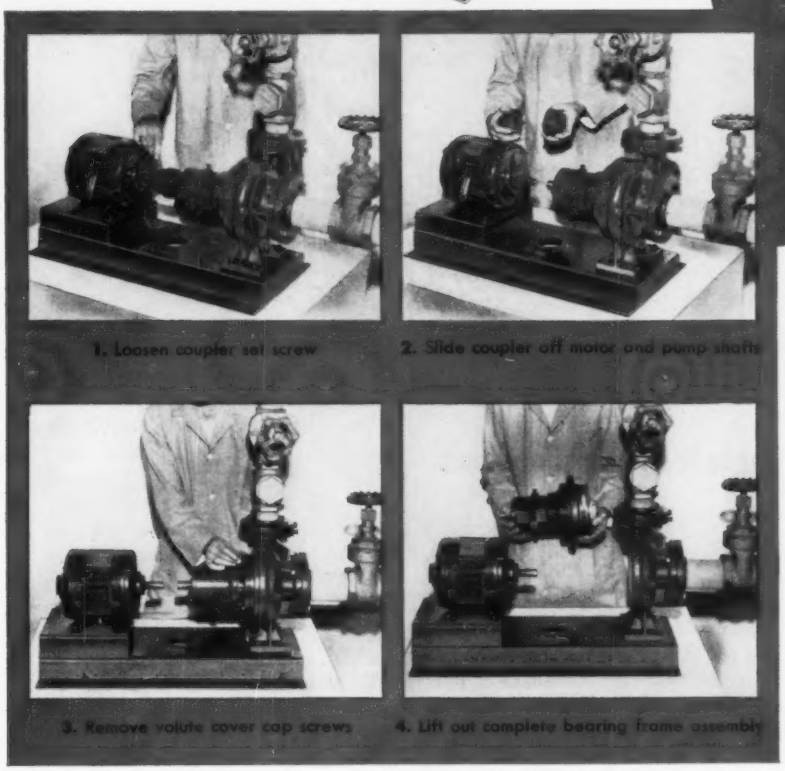
New basic-unit design electrical network analyzer has a control-center arrangement to accommodate any future expansion of analyzer facilities—check page 106 for details.

Research scientists in industry may feel such a lack of prestige that they falsify questionnaires about the work they do, ASME reports. Suggested solution: give them more basic research, fewer clerical tasks.



EASY TO SERVICE THIS VERTICAL SPLIT-CASE PUMP

B&G SERIES 1510-B CENTRIFUGAL PUMP


1. Loosen coupler set screw
2. Slide coupler off motor and pump shafts
3. Remove volute cover cap screws
4. Lift out complete bearing frame assembly

The photos show how easily the complete bearing frame, including seal and impeller, can be removed without disturbing piping or motor leads. The unit is replaceable and interchangeable in all pump sizes within limits of material construction.

Other features of the 1510-B include—

Mechanically balanced impeller. Balancing chamber and pressure relief holes in the impeller reduce thrust to a minimum, lengthening pump life.

Solid-type volute with support foot. Can be left in pipe line when servicing pump—rugged construction absorbs piping strains.

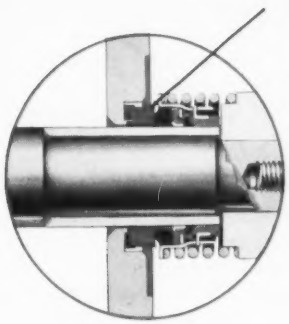
Anti-friction roller bearings. Timken bearings handle thrust and radial loads for smoother, quieter, more efficient operation.

Oil lubrication. No messy, undependable grease cups—circulating oil lubrication assures positive protection to bearings. Oil level indicator permits visual check.

Rugged steel base. Base mounted construction provides a sturdy platform for proper pump and motor alignment.

100% factory tested. Every pump hydraulically tested to meet specified conditions of head and capacity.

Capacities. To 1100 GPM, heads to 420 ft.



LEAK-PROOF "REMITE" SEAL

This exclusive feature assures long, trouble-free life—eliminates the customary leakage which occurs when a packing gland is used. A carbon seal ring faces on a "Remite" floating seat —a material developed by B&G, so hard it will scratch glass—wear-proof and corrosion-resistant.

This mechanical seal is self-lubricating. A synthetic rubber bellows seals the shaft. Metal parts are of steel, bronze or stainless steel, depending upon the type of service.

STOCK PUMPS FOR QUICK SERVICE

Selected sizes of B&G Series 1522, 1531 and 1510-B Centrifugal Pumps are stocked at the factory for immediate shipment. Capacities to 225 GPM, heads to 140 ft. Send for Price and Selection Catalog.

Reg. U.S. Pat. Off.

BELL & GOSSETT COMPANY

Dept FJ-36, Morton Grove, Ill.

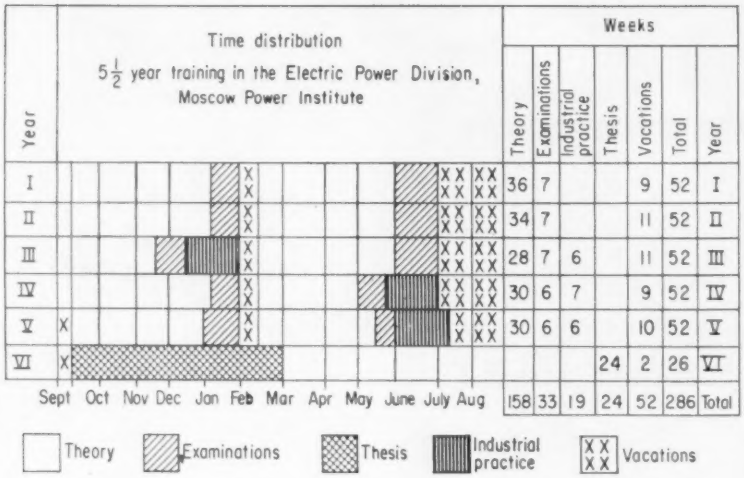
Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto 16, Ontario

Technical briefs

Latest engineering developments for busy power men

14 papers for you on:

HEAT TRANSFER
INSTRUMENTS
LUBRICATION



How Russia trains electrical engineers

Electrical engineering education and research in the U.S.S.R. *By P A Abetti and G F Lincks, General Electric Co*

After a brief review of primary and secondary education in the U.S.S.R., the authors discuss undergraduate and postgraduate training, and major research and technical activities in the power field. They give examples of typical electrical-engineering curricula and describe some outstanding educational and research institutes.

In some cases, they give figures for American data corresponding to the Soviet data, to facilitate numerical comparisons.

Engineering courses in the Soviet Union last 5½ years, divided up as shown in chart, above. Excluding the thesis and industrial practice, total hours of instruction range between 5000 and 5500. The 1000 to 1100 hours of the fifth year are concentrated wholly on the student's specialization, such as steam-electric or hydroelectric stations, electric circuits or systems. Such specialization is only possible in a country like the U.S.S.R. where everyone works for the government and the availability of positions is known in advance. For comparison, the engineering curriculum for the BS degree in the U.S.A. comprises in total 3000 hours or less. However, the American graduate specializes in one phase of his major after he enters industry rather than in a fifth year at college.

Among other things, the authors conclude that (1) Russia's education in engineering provides a basic foundation in the first two or three years and then peaks to a high degree of specialization, most of all in the fifth year. (2) Soviet educational institutes and universities, reported to be graduating 60,000 engineers, use their facilities for approximately the same number of hours per day and months per year as in the U.S.A. The ratio of students to teachers is also similar. Thus it appears that U.S.S.R. has physical facilities and teachers far in excess of those available in the U.S.A., where we are presently heavily taxed to graduate 25,000 to 30,000 engineers per year. (3) Capable students are aided in securing a higher education in engineering or other subjects by free or low tuition and by payment of a monthly stipend. (4) U.S.S.R. research facilities in scientific and educational institutes are excellent. *AIEE paper, No. CP-58-147*

Heat transfer

Boiling heat transfer to water containing a volatile additive. *By G Leppert and C P Costello, Stanford University and B M Hoglund, Argonne National Laboratory*

Aspects of local boiling in forced circulation when the boiling fluid contains small percentages of alcohol are discussed. Particular emphasis is placed on the improvement in smoothness of boiling and in the decrease of average bubble size when the additive is present, as contrasted with boiling distilled water. Experimental results are presented for surface boiling from the outside of a cylindrical stainless-steel tube placed normal to the flow. Data are also presented for subcooled boiling of distilled water, and comparisons made with correlations from the literature. *ASME paper, No. 57-A-81*

Hydraulic analogy for transient cross-flow heat exchangers. *By S Juhasz, Southwest Research Institute*

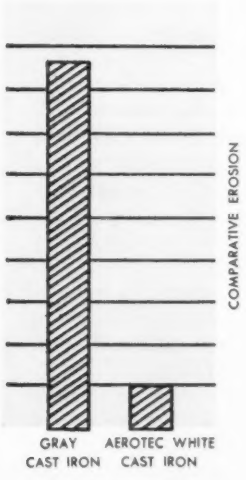
The analogy discussed in this paper is related to a one-pass transient crossflow heat exchanger with longitudinal heat-conduction in one of the fluids and in the heat-transfer surface.

The analogy is composed of vertical liquid bottles (memories) with liquid-level reading scales (input and output). The bottles are connected with capillaries (arithmetic units). Rotary valves (controls) are used to change the connection between the bottles in a predetermined way.

In this analogy, time corresponds to time in the prototype and is continuous. Space in the analogy is lumped, the liquid quantity in the

AEROTEC PIONEERS A NEW POLICY

. . . mechanical fly ash collector guaranteed for 100 months



Bar chart shows comparative loss in weight of white iron vs. gray iron during identical accelerated abrasion tests.

Never before in the art of mechanical dust collection has a tube service-life guarantee been offered. Today, Aerotec gives such a guarantee on the Design 5RWS white cast iron tube, the result of more than ten years of research and field tests. Aerotec guarantees the tubes for one hundred months. Replacement tubes during the first thirty-six months will be furnished from the factory at no charge to the purchaser. Thereafter, replacement will be made at a pro-rata charge based on 100 months of warranty. Such a guarantee could only be offered after extensive research and field tests. The background of this research is briefed in two bulletins—DATA SHEETS 1-TTC-1 and 1-TTC-2. Your copies of these and the complete warranty will be gladly sent on request to our Project Engineers. Why not write today. If you have a dust collecting problem, Thermix will also be glad to discuss it with you.

Project Engineers

THE THERMIX CORPORATION

Greenwich, Conn.

(Offices in 38 principal cities)

Canadian Affiliates: T. C. CHOWN, LIMITED, Montreal

Manufacturers

THE AEROTEC CORPORATION

Greenwich, Conn.

bottles represents the quantity of heat in the heat exchanger, and a given bottle represents a lumped section of the hot-fluid heat-transfer material, or the cold fluid. Liquid level corresponds to temperature, and cross-sectional area corresponds to specific heat. Capillaries are used to represent either heat conduction or heat convection.

Movement of one of the several rotary valves of the first kind, with one step, stimulates movement of the hot fluid relative to heat-transfer surface, and movement of the rotary valve of the second kind with p steps represents movement of the cold fluid relative to the heat-transfer surface. Here p equals number of spacial subdivisions in the x direction. *ASME paper, No. 57-A-125*

Vapor formation and behavior in boiling heat transfer. *By R A Egen, D A Dingee and J W Chastain, Battelle Memorial Institute*

An experimental program was conducted to study formation, distribution of vapor in a rectangular channel under boiling-heat-flux conditions at 2000 psia. In addition, problem of preferential distributions was studied to determine its effect on the validity of program's results.

Over the range of variables tested there was no flow-rate effect, and the slip, where determinable, appeared to be constant. The void fraction is correlated with quality and heat flux, in the vicinity of zero quality; dependence upon heat flux decreases with increasing quality in this region. Inlet-temperature variation has no effect on the value of the void if temperature is below that necessary for local boiling. *ASME paper, No. 57-A-74*

Instruments, controls

Survey of mathematical methods for nonlinear control systems. *By J M Loeb, Schlumberger Well Surveying Co*

This paper is a survey of presently known mathematical methods applicable to nonlinear control problems. After emphasizing the need for general theories which alone can facilitate equipment design, the author discusses (1) phase-plane and phase-space methods for graphical representation of general system behavior (2) describing-function analysis of limit cycles (3) piece-wise linear analysis (4) probability calculus for the study of noise and random inputs in nonlinear systems (5) energy-balance and stroboscopic methods which apply to particular features of a system. *ASME paper, No. 57-A-104*

A new type of hot-element directional anemometer. *By K-E Hassan, University of Cairo*

A new type of directional hot-element anemometer has been developed, calibrated and used. It is built of a platinum tape that can be heated electrically in the same manner as the usual hot-wire anemometer. The instrument indicates the direction and measures the magnitude of fluid velocities. It is of simple construction and can be made and calibrated with relative ease. *ASME paper, No. 57-A-197*

Straightening vanes for flow measurement. *By R E Sprenkle and N S Courtright, Bailey Meter Co*

A new flow straightener, the multiplate type, has been devised to produce uniformly turbulent flow at the primary element (flowmeter). It consists of three plates in series, spaced about one diameter apart. Each plate has a large number of round holes arranged in symmetrical pattern.

The authors conclude that the multiplate or multiscreen type of flow straightener effectively eliminates swirls, whirls and other disturbances in the flow pattern, making it possible to obtain accurate flow measurements regardless of the geometry of the piping system preceding the flowmeter section.

Until sufficient operating experience has been obtained, it may be advisable that this flow straightener be installed in a bypass line together with the primary element so that possible accumulation of extraneous matter can be removed without shutting down the process. *ASME paper, No. 57-A-76*

Directions for ordering papers on page 210

Lubrication

The role of atmospheric oxidation in high-speed sliding phenomena—II. *By M Cocks, Ford Motor Co*

An experimental study of the role of oxidation due to frictional heating in unlubricated high speed (13,000 fpm) sliding of metals is discussed. The paper gives a general picture correlating the results for several metal combinations and also a bonded metal carbide.

Results indicate that the oxidation gives considerable protection against surface damage. With copper on copper (previously run-in), copper on steel, and bonded tungsten carbide on bonded carbide relatively little tearing of the metal (or carbide) is observed at light loads. The oxidation should increase with increasing load, and these combinations behave like steel on steel in that on at least one of the surfaces there is, if anything, even less metallic tearing at high load.

At low loads wear is mild, in harmony with the oxide protection, but at higher loads severe wear is attributed to disintegration within the oxide itself. With nickel on nickel the oxidation fails to prevent fairly severe metallic tearing even at high loads. Some consequences of these phenomena in the variation of friction, wear and surface damage with load, speed and sample geometry are described. *ASLE paper, No. 57LC4*

Chrome face vs iron side wear—an analysis of some radioactive piston-ring wear studies. *By R G Abowd, Jr, Ethyl Corp*

Wear of piston rings in internal combustion engines—and the role of lubricating oil in modifying this wear—has been described by a number of investigators in recent years. In most of these investigations un-

(*Continued on page* 204)

TWO KEELER DK PACKAGE STEAM GENERATORS provide

STEAM *for* HEAT, HOT WATER and AIR CONDITIONING

THE DALLAS MEMORIAL AUDITORIUM

— Architect-Engineer —
George L. Dahl Architects & Engineers
Dallas, Texas

— General Contractor —
R. P. Farnsworth & Co., Inc.
New Orleans, La.

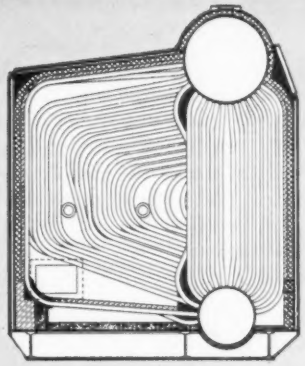
— Heating, Plumbing, Air Conditioning —
C. Wallace Plumbing Co., Inc.
Dallas, Texas

After well over a year of service in this fabulous community center, the two 15,000-lb. capacity gas-fired Keeler D K Package Steam Generators are still winning highest commendation. *"Performance 100% perfect . . . very economical and up to date . . . operating without trouble"*—are just a few of the comments!

The Dallas Memorial Auditorium is typically Texas-big . . . 1,773 seats in its theatre, 10,439 seats in its arena, over 110,000 square feet of exhibit space, a spacious lobby—422,710 square feet of total area! It's heated and air conditioned throughout with low cost, low maintenance steam from two 250 psi design pressure Keeler D K Package Steam Generators.

The heat and hot water requirements of the auditorium are met with time-proven Keeler dependability . . . and steam from the same units drive the turbines for the air conditioning system's two 775-ton centrifugal refrigeration compressors—with capacity to spare!

Multi-purpose Keeler D K's offer the popular D-type tube arrangement in a completely steel encased package, with water cooled and insulated furnace sides, roof and floor as well as front and rear walls. Write or phone for full specifications . . . *Keeler versatility is at your service!*



KEELER Type DK

COMPACT PACKAGE POWER PLANTS

- Oil or gas fired.
- Steam capacities up to 60,000-lbs. per hour.
- Design pressures: 200 to 500 psi.
- Uniform diameter water tubes facilitate cleaning or replacing.
- Tube-to-tube construction on both sides provides greater percentage of radiant heating surface.

— ESTABLISHED 1864 —

The Seal of Quality in Water Tube Steam Generators

E. KEELER COMPANY

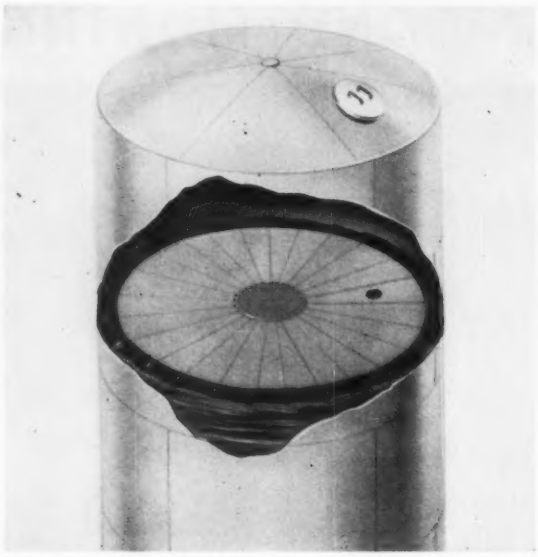
200 - 300 West St. • Williamsport, Pa.

— OFFICES IN PRINCIPAL CITIES —

KEELER WATER TUBE *Boilers*

Plant equipment news

Your information center for new products and materials



FLOATING PLASTIC ROOF reduces evaporation, cuts corrosion

INSTALLED IN SEGMENTS, complete roof will support a man

FLEXIBLE NEOPRENE edge seal fits snugly around obstructions

Do-it-yourself cover keeps tank losses low

801 • Plastic cover for small-diameter fixed-roof tanks is installed in sections through the roof manhole, and floats on top of the liquid to cut down on evaporation, breathing and filling losses.

The cover assembly is made of rigid polyisocyanate foam, said to have low density and high load-carrying capacity. Cellular structure makes the foam more buoyant. It can withstand –94 to +300 F.

Unit comes in pie-shaped segments, which can be assembled with slip-fit joints by plant's maintenance crew. Each segment has a flexible neoprene seal attached to its outer edge, forming a loop which acts as an edge seal so that cover can operate efficiently in a tank with inside obstructions. The cover can be disassembled and moved to another tank without any service break.—*Hammond Iron Works, Warren, Pa.*

For more data on these items, use post cards on page 161. Identify your request with item number

Strainer cuts cleaning time to ten minutes

802 • Large start-up strainer protects boiler-feed, condensate and circulating pumps in new piping construction. Steel strainers come in 6- to 16-in. sizes with 150- or 300-lb flanges. "Straight-through" construction is said to keep the pressure differential across the strainer down. Easily removable screen permits strainer body to be left in line permanently or replaced with a spool piece.

Screen can be cleaned by inserting an air, steam or water lance and flushing trapped debris down the clean-out drain. This is said to cut cleaning time to ten minutes. Up and downstream bosses measure pressure drop, signal cleaning need.—*Leslie Co, Lyndhurst, N.J.*

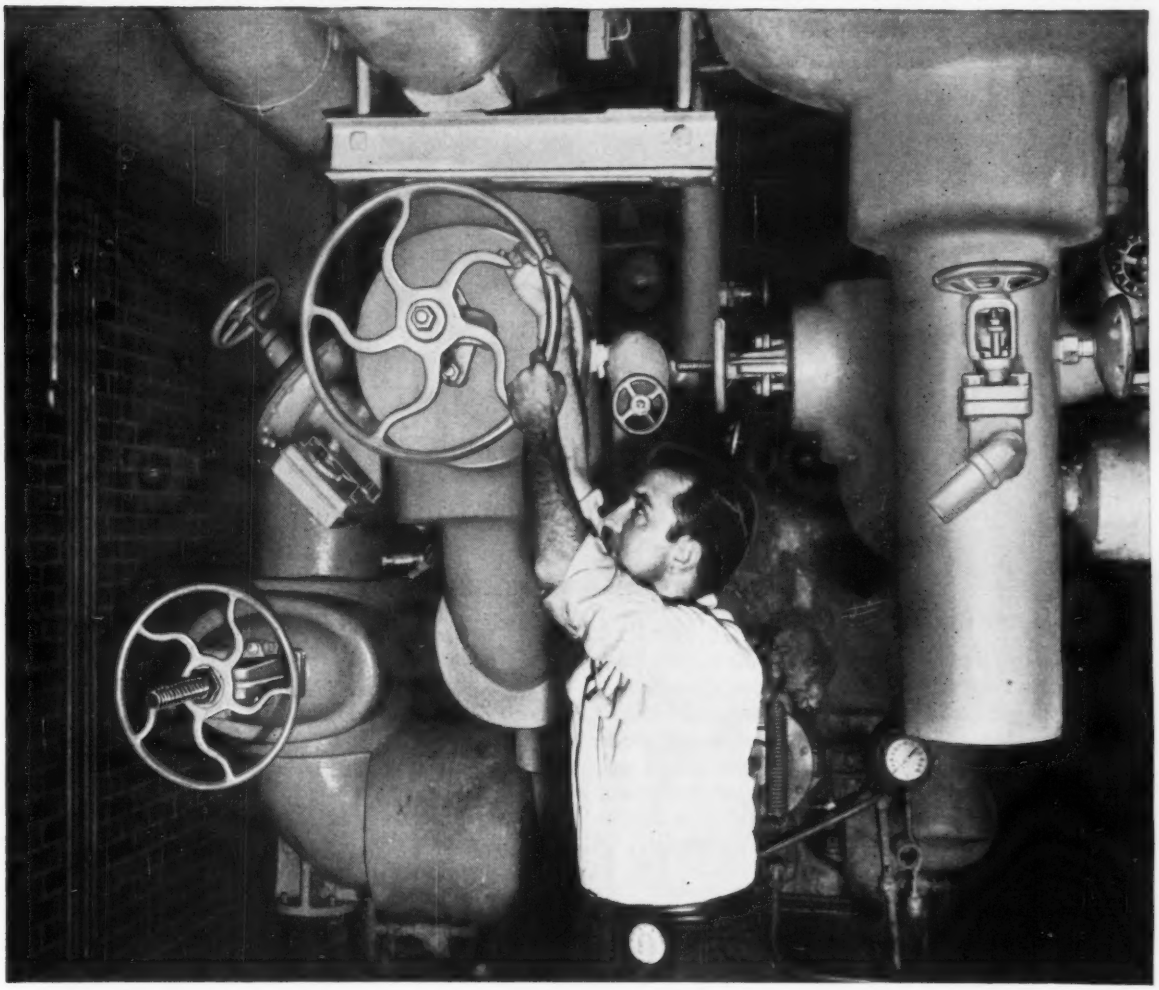
Ion-exchange resin holds 30.5 kgr per cu ft

803 • Strongly basic porous anion exchanger is said to have an unusually high volumetric capacity. Maker recommends it for treatment of all waters containing high molecular-weight organic compounds.

Since the resin beads are porous, they absorb large organic molecules readily, and release them readily during regeneration.

Material is designated *Amberlite IRA-402*. Its capacity is up to 30.5 kgr per cu ft, as $CaCO_3$, according to the manufacturer. It comes in chloride form, at a shipping density of 45 lb per cu ft.—*Rohm & Haas Co, Resinous Products Div, Washington Square, Philadelphia 5, Pa.*

Cities Service shows how to cut valve costs



Crane globe valve in 14th year on steam turbine line

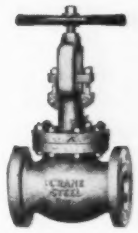
Cities Service Refining Corp. uses hundreds of valves at its Lake Charles, La., plant. Maintenance and replacement costs could be staggering, but for careful control of valve selection.

For example, the Crane 6-inch, 300-pound steel globe valve shown above was installed at the Lake Charles plant 14 years ago. Working at 250 psi., 600 deg. F., the valve is used in the steam line to a turbine-driven feed-water pump.

In spite of its operation 3 or 4 times a week, this sturdy Crane valve has continued tight in service and has required no repairs in 14 years!

Thrifty buyers want no better reward than the kind of cost-cutting, dependable service they get when Crane valves are installed.

That's why in the petroleum industry, as in all industries, you'll find more Crane valves used than any other make.



This is the valve used on installation above. CRANE 151XR, 300-pound cast steel globe valve for 850° F. maximum temp. Sizes: 2 in. to 8 in. For full details, see your Crane Representative, or write to address below.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • KITCHENS • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill. Branches and Wholesalers Serving All Areas

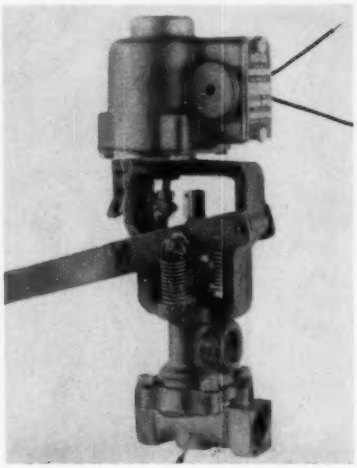
In Canada: Crane, Limited, 1170 Beaver Hall Square, Montreal, Que.

Gear adapter for h-p valves

804 • Lightweight planetary gear operator adapts wrench-adjusted h-p valves already in service to gear operation. Unit has a 5:1 gear ratio and a 4:1 mechanical advantage. One turn closes or opens valve.—*Rockwell Mfg Co, Meter & Valve Div, 400 N Lexington Ave, Pittsburgh, Pa.*

Valves for 150-psi steam

805 • Union-bonnet, composition disk, globe and angle valves are for general use. Rated for 150 lb working steam pressure or 300 lb of water, oil or gas, they're suited for process and maintenance lines where tight shutoff is needed.—*Ohio Brass Co, Mansfield, Ohio.*



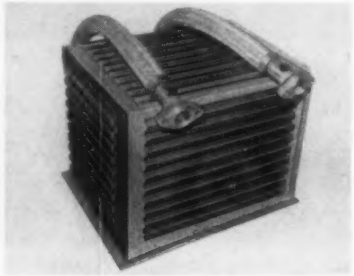
Solenoid valve is hand reset

806 • This 3-way valve can be manually set and held in one position, and returned to its original position electrically. The unit has a forged-brass body and cast-iron operating mechanism. Available for ac or dc in various enclosures.—*Automatic Switch Co, Florham Park, N.J.*

Heat exchanger handles 1000 F

807 • Small, rotary air-to-air heat exchanger can take waste gases at temperatures as high as 1000 F.

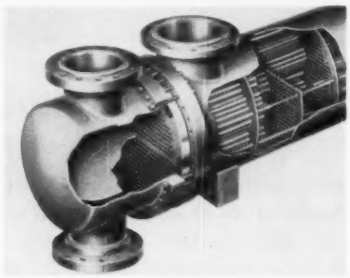
The 20-in. dia, 11-in. deep model handles flows of 250 cfm, and units can be arranged in parallel to accommodate flow rates over 2600 cfm. Chief component is the rotor which is made up of individual sector-shaped baskets containing the heating element.—*Air Preheater Corp, 60 E 42nd St, New York, N.Y.*



Exchangers have high capacity

808 • Standard and custom-designed high-capacity heat-transfer line is said to operate under reduced pressure with a high degree of heat exchange for heating, cooling.

Units can be used as oil and fuel coolers; as air-to-air, liquid-to-air, liquid-to-liquid and saturated-vapor-to-air exchangers; as evaporators and condensers for compartment cooling. —*Tenny Engineering, Inc, 1090 Springfield Rd, Union, N. J.*



Floating-head unit is flexible

809 • Predesigned, fully standardized line of exchangers is designed for the chemical industry. Flexibility is provided in materials, size and arrangement of components, mounting position, tube side passes.

The units have a floating head and removable bundle and are available in 1-, 2- and 4-pass designs. Official designation is *C-100.—American-Standard, Ross Heat Exchanger Div, Box 2081, Buffalo 5, N.Y.*

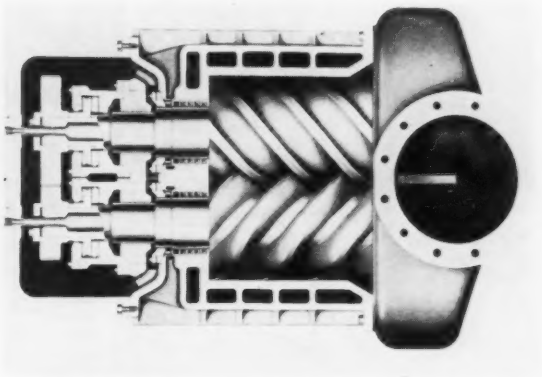
For more data on these items, use post cards on page 161. Identify your request with item number.

Begins on page 148

Twin-unit compressor delivers 1200 cfm

810 • Claimed to be the largest portable rotary air compressor, this twin-unit model is said to give top flexibility. Each unit of the 2-stage oil-cooled sliding-vane compressor has independent controls. The units can be operated separately to deliver 600-cfm of free air at 100 psi or together for 1200 cfm delivery. Since units are similar, parts can be interchanged for servicing.

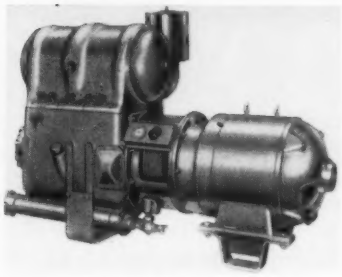
Dry weight is 14,700 lb, dimensions are 14½x8x8. Modulation is separate or simultaneous, and the compressor is powered by *GM 6-71* diesel engines.—*Westinghouse Air Brake Co, Le Roi Div, Milwaukee 1, Wis.*



Compressor boasts efficiency, compactness

811 • Positive-displacement general-purpose rotary compressor is said to combine the efficiency of a reciprocating machine with the compactness of a centrifugal unit. Standard capacity range of the 2-impeller helical-lobe axial-flow line is 800 to 13,000 cfm.

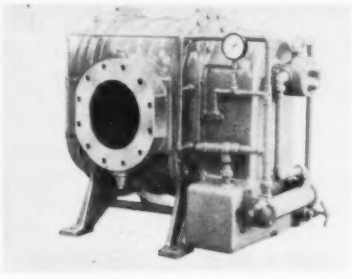
Power is transmitted to the secondary impeller through a cushion of compressed gas. Since there's no metal-to-metal contact, no impeller lube is needed, so output is always oil free. Maintenance is said to be low because there are no valves or pistons to wear.—*Fairbanks, Morse & Co, 600 S Michigan Ave, Chicago 5, Ill.*



Heavy-duty unit gives 420 cfm

812 • Rotary 100-hp industrial compressor is designed for continuous operation at 100 psi, delivering 420 cfm. It can be used intermittently for pressures to 125 psi.

Features are low vibration, the 15 sq ft of floor space needed, installation without a special foundation, and a 3-in. outlet. Discharge temperature is 180 F. Air-cooled model *100DA* is 98x30x53 in., weighs 3800 lb; water-cooled *100DW* is 11 in. shorter, 100 lb lighter.—*Davey Compressor Co, Kent, Ohio.*

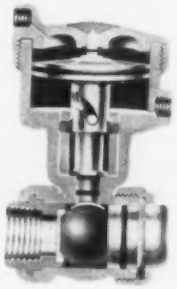


Vertical-impeller blower takes up little space

813 • Vertical arrangement of impellers provides horizontal inlet and discharge connections for more convenient piping on this new blower. Flanged-stub shaft design permits higher pressure rating for a given impeller length, for good displacement without extremely high speeds.

Double shaft seals are said to keep the air or gas oil free. There are 36 sizes for 2000 to 14,000 cfm, 6 psig or for 1500 to 8000 cfm, 10 psig. — *Roots-Connersville Blower, 900 W Mount St, Connersville, Ind.*

Don't miss this item



Molded valve operator ... p 167

. . . or other product news appearing on following pages

Electronic fish control ..... p 164
Size-identified rings ..... p 164
Heating, ventilating unit ... p 167
Replaceable cleats ..... p 168
Insulating cement ..... p 168
Steam, heating boiler ..... p 171
Heat-exchanger tube ..... p 172
Double-duty belt ..... p 172

George Edwards

warns: "You pay a big price for ducking decisions"

While browsing among the exhibits at the Automation Show in New York last June, I bumped into Ray Whittaker, who has a smallish but bustling instrument-repair business in Detroit. Back in 1952 Ray was planning to retire and let his son take over, but the boy never made it back from Korea. So Ray stayed at the helm. Last time I saw him, about two years ago, he was grooming a young fellow to take his place.

"I'm gonna take it easy," Ray had told me. "Soon as this boy gets a good grip on the reins, I'm going to let him do the driving. He'll do all the leg work and later on, if he's as smart as I think he is, he'll wind up owning the place."

I remembered thinking what a terrific opportunity Ray was giving this guy. Mildly surprised at seeing him at the show, I made some remark about a retired fire horse chasing the engine.

"The deal didn't pan out," Ray said as we relaxed over a cup of coffee, "for the same reason the boy quit his job with the potato farmer. Ever hear the story?" I shook my head and said I hadn't heard the potato-farmer story.

"Well," Ray began, "a young fellow knocked at this farmer's kitchen door one day and asked if he could do any odd jobs in exchange for something to eat. The farmer liked the boy's looks and, over a big plate of ham and eggs, learned that he was looking for something steady, that he was willing to work hard and to learn all he could in a determined effort to make a future for himself.

"The farmer explained that his main crop was potatoes and that he could use a good man. The work wasn't hard—the place was completely mechanized—but he and his wife were getting along in years. The business of grading the potatoes and getting them ready for market—certain sizes brought better prices than others—was getting to be a little too much for them.

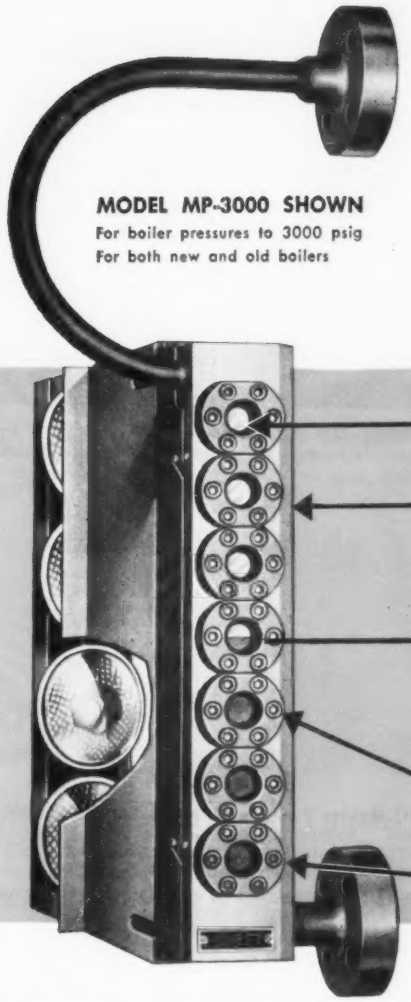
"Taking the young fellow down by the barn, the farmer showed him a sizable mound of potatoes that was ready for sorting. 'Really not much to it,' said the farmer. 'Little potatoes go in one bin, big ones in the other.' He told the boy he'd give him room and board plus a salary that made the fellow's eyes pop. Told him further that the place offered a real future.

"The young fellow set to tossing potatoes in the bins with a will. Kept it up for three days. Fourth day he told the farmer he was quitting. Farmer asked if the work was too hard. No, the job was an easy one. Not enough money in it? No, it was good pay. Well, what was the trouble? The boy shifted from one foot to the other, then blurted, 'Well, it's sorting those potatoes. Putting the little ones in one bin and the big ones in the other. It's an easy job as far as work goes, but those doggone decisions are killing me!'"

MORE THAN ~~950~~ ~~1400~~ 2000

DIAMOND MULTI-PORT GAUGES

In use and on order for over ~~240~~ ~~300~~ 315 Central Station Generating Plants



MODEL MP-3000 SHOWN
For boiler pressures to 3000 psig
For both new and old boilers

SMALL ROUND PORTS INSTEAD OF LONG GLASS AND MICA STRIPS

GAUGE NEVER REMOVED FROM BOILER FOR GASKET CHANGES OR OTHER NORMAL MAINTENANCE

STEAM SHOWS RED
WATER SHOWS GREEN

Also available is Model MP-900 for boiler pressures to 900 psig

COMPLETE PORT CHANGE REQUIRES ONLY ABOUT 15 MINUTES

EACH PORT THERMALLY INDEPENDENT

Because the Diamond Multi-Port solves the problems inherent in water level gauges on boilers operating at high temperatures and pressures, it has had rapid and wide acceptance. In addition to the 2000 for central station generating plants, more than 185 have been sold to industrial power plants.

Advantages of the Multi-Port are many. In addition to those shown above, it has maximum thermal stability for rapid starting . . . "Hi-Lite" illuminator for improved readability . . . welded construction for permanent tightness . . . end stems can be furnished instead of flanges . . . startling reductions in maintenance costs.

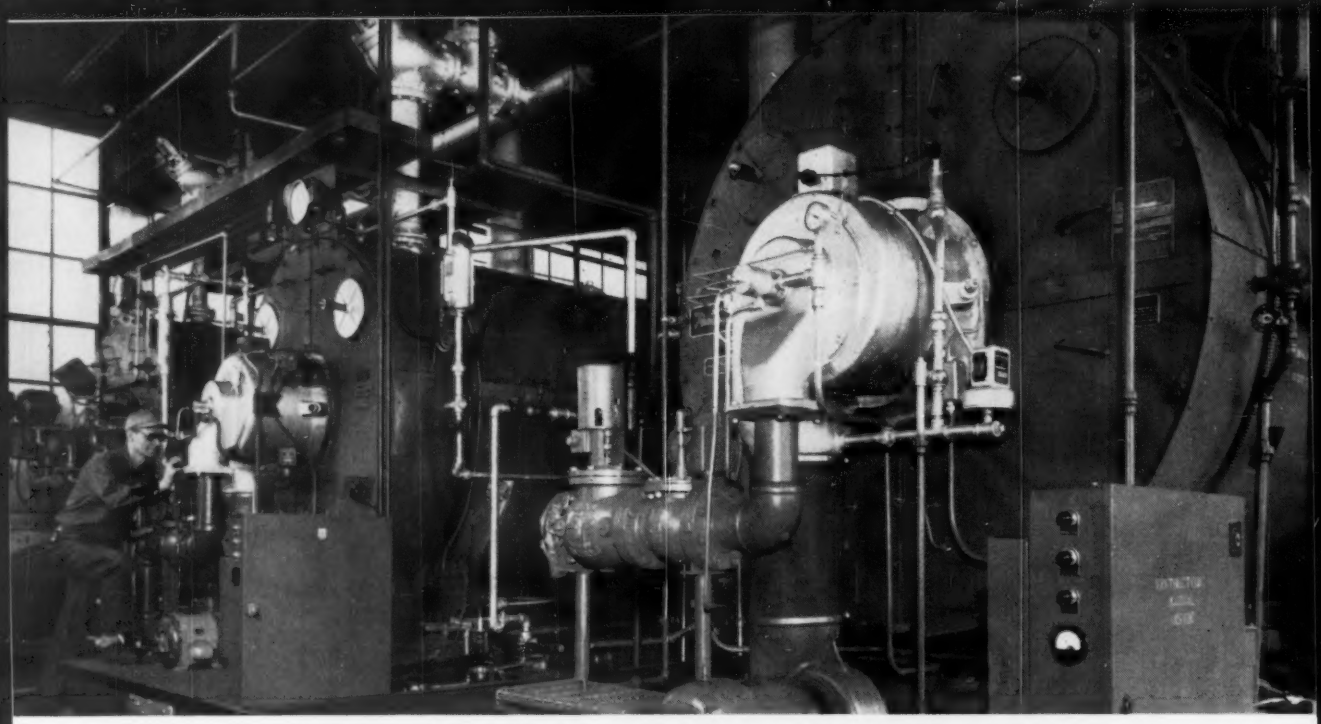
Write for Bulletin 1174 (Model MP-3000) or Bulletin 2044 (Model MP-900) for more information.

8032

Diamond

DIAMOND POWER SPECIALTY CORP.

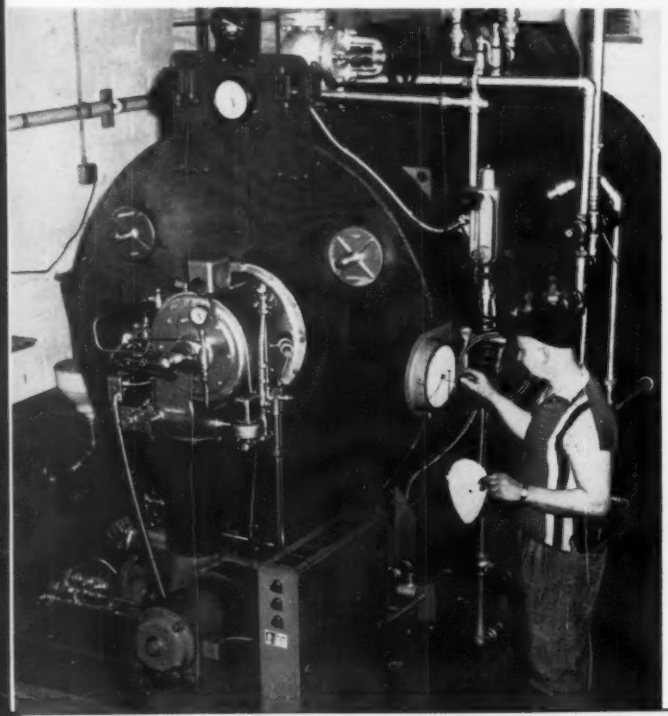
LANCASTER, OHIO • DIAMOND SPECIALTY LIMITED — *Windsor, Ontario*



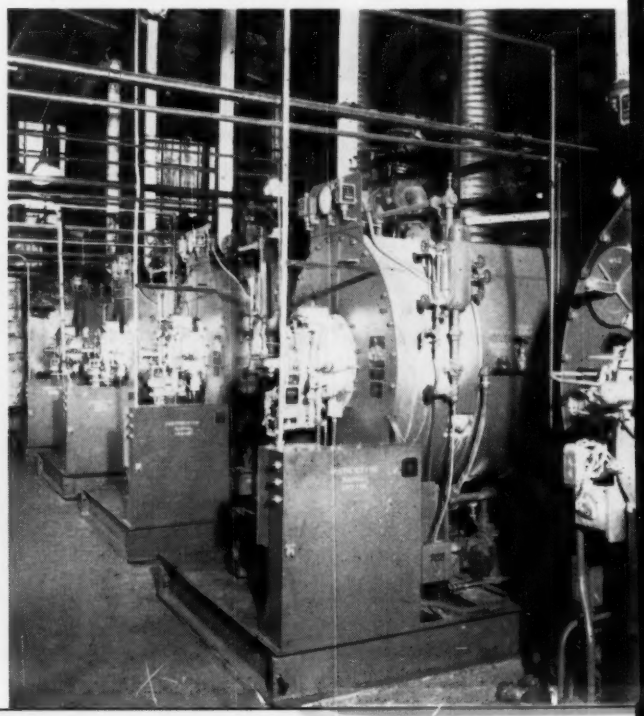
ILLINOIS Machinery Manufacturer SAVES 75% of boiler room attendance, REDUCES maintenance and fuel costs . . . by replacing stoker-fired boilers with three oil-fired *Powermasters* over 10-year period. Operated 24 hours daily, 7 days a week, the packaged automatic boilers supply varying multi-purpose steam need with impressive savings.

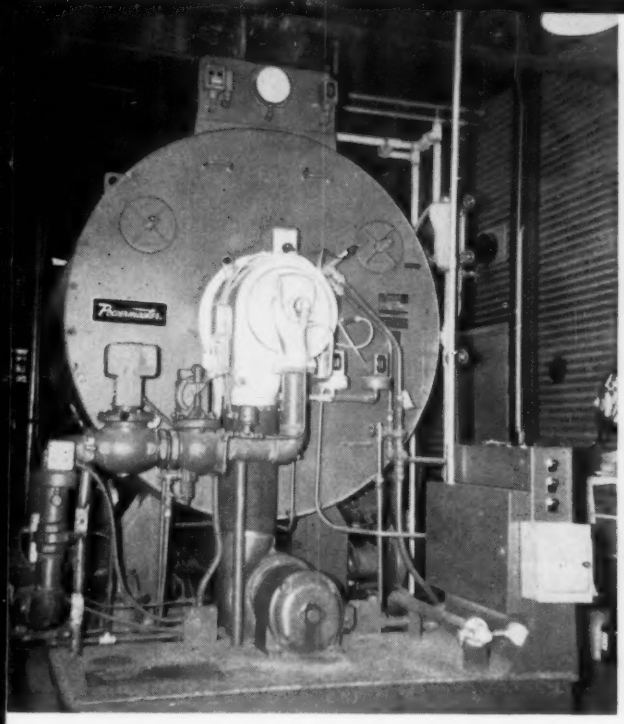
O&S® *Powermaster*® "packages"

NEW YORK Dairy SAVES $5400 yearly in fuel oil . . . gets additional benefits of reduced maintenance, increased efficiency and constant steam pressure under widely varying loads . . . by boiler modernization with *Powermaster*.



OHIO Rubber Products Company SAVES $26,000 yearly in labor . . . with battery of *Powermasters* in place of four larger boilers. Operating and maintenance economies paid off cost of packaged units in two years.





NEBRASKA Laundry-Dry Cleaner SAVES $3500 yearly on gas fuel bill . . . by switching to *Powermaster*. Its infinitely variable firing rate that instantly responds to load changes assures high fuel economy, saves maintenance.

INDIANA School SAVES 1200 sq. ft. of space, operating and maintenance costs, and man-hours . . . by converting firebox boilers to modern automatic gas firing with O&S Packaged Burner Systems—same as used on *Powermasters*. Modernization also increased heating capacity, reduced building upkeep.

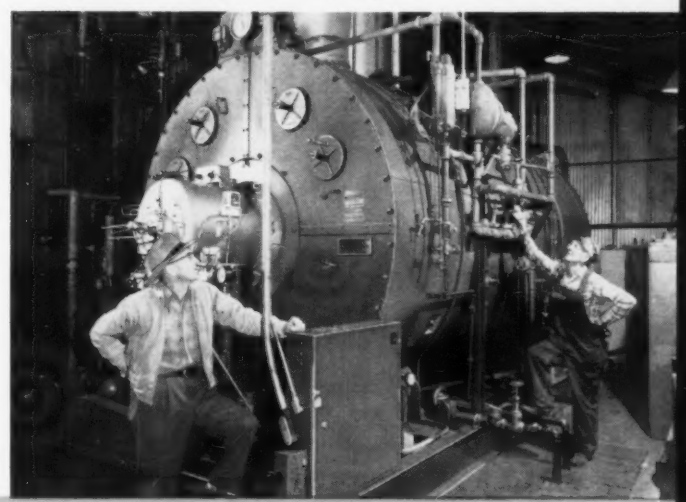
earn BIG boiler-room profits!

O&S *Powermaster* Packaged Automatic Boilers and O&S Burner Systems are real *cost-cutters!* That's why a fast-growing number of these money-saving "packages" are replacing other boiler equipment to assure low-cost and dependable steam for process and heating needs. Modernization with O&S packaged boilers and burners is paying off impressively in industrial plants, institutions, food industries, laundries, schools, stores, public buildings, churches and many other establishments.

Low-cost space saving installation, fuel-saving efficiency, labor-saving automatic operation, fast-steaming, instant response to load swings, time-saving inspection and upkeep, clean operation, and dependable performance are important advantages gained with O&S money-saving packaged units.

Find out how O&S packaged boiler equipment can pay off for you . . . as replacements for existing equipment or in new construction. Ask to see actual proof of savings . . . send for informative bulletins.

OREGON Food Packer SAVES steaming time . . . with *Powermaster*. Installed for standby, the packaged boiler now operates full time with a water-tube unit used intermittently as needed. *Powermaster* full-range modulation is big cost-saving advantage for off-peak winter heating.



packaged automatic BOILERS
15 to 600 HP sizes pressures to 250 psi

ORR & SEMBOWER, INC.

Reading, Pa.

packaged automatic BURNERS oil-gas combination

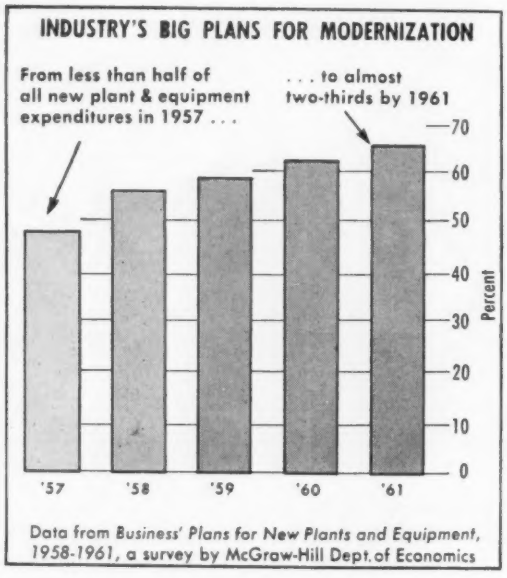
Since 1885 builders of dependable boiler equipment for all industries

PLAN '59

A MESSAGE TO AMERICAN INDUSTRY

Modernize Now — For Growth and Profits

The biggest challenge facing American industry today is that of thoroughly modernizing its plant and equipment. This is the test period for companies to prepare for success — or failure — in the '60s. Success depends decisively on one key policy — modernization, for growth and profits.



The problem of business recession is fading. Sales and industrial production are moving up again, slowly. Business is swinging back into its normal course. This is growth, not retreat and recession. If the recovery takes us back to the normal growth trend, industrial production will be up 15% to 20% by 1960.

But how can we get this growth in production without the plague of price inflation that has blighted our economy in recent years? And, of fateful consequence for the individual business firm, how can it keep its costs down enough to make a decent profit — something a very large share of American companies are not doing today?

This is the new challenge that confronts business as the recession is left behind.

Nature of the Challenge

The recent record on costs and productivity is not reassuring. Since 1947 wages in manufacturing have risen 68%, while output per manhour has gone up 32%. This is a dismal record for a nation that has prided itself on

gains in industrial efficiency. Clearly, if we are to avoid continuing inflation, labor must key its wage demands more closely to productivity increases. But clearly, also, we must do far better in raising output per manhour. Otherwise, industry cannot hope to offer stable prices, and still make a profit.

What, then, is the answer? It is modernization of plant and equipment, the replacement of obsolete producing facilities with new and more efficient machinery and buildings. Only in this way can industry hope to increase production, hold down costs and make a good profit showing in the years of growth that lie ahead.

Industry's Answer

The chart on the preceding page shows how American industry is buckling down to the task of modernizing its facilities over the next four years. It is planning to replace old equipment with new machines that will raise output per worker not just 2% or 3% a year, but more like the 5% annual gain in productivity that this nation achieved in the years following World War I.

Since World War II we have had to contend with shortages of capacity and materials that have held back the job of raising productivity. But today the machines and techniques are available. And industry is getting set.

A broad sample of manufacturing companies surveyed by the McGraw-Hill Department of Economics earlier this year reported these plans: **In 1958, expenditures for modernization will rise to 56% of total investment in new facilities — compared to 48% in 1957. And this emphasis will increase until by 1961, expenditures for replacement and modernization account for two-thirds of all capital spending by manufacturing companies.** In dollar terms, manufacturers will spend more on modernization in each of the four years 1958-61 than in any previous year except 1957.

Can It Be Done?

These are big plans. Can they be carried out? Is it too visionary to hope that after a decade of expansion, industry can now find the outlets for huge amounts of capital investment in the area of modernization? The answers are important to business and the nation, because on this new wave of modernization depends our hope of holding down costs and prices, and also the prosperity of the vital capital goods industries — generators of boom and bust in our economy.

To ensure that industry gets the answers, McGraw-Hill's 34 business publications are now starting a coordinated effort — the largest editorial effort in the history of our company — to find, report and publish the opportunities for modernization at a profit, in the fields we serve. These special reports will begin in late September and will run through November, with appropriate coverage for the specific needs of each field. We are proud to share with industry the responsibility for making sure that no opportunity is overlooked in the drive to modernize now for growth and profits.

This message was prepared by the McGraw-Hill Department of Economics as the first step in our company-wide effort to report on opportunities for modernization in industry. The Department is also preparing a longer report, on modernization as a national problem, for publication in October.

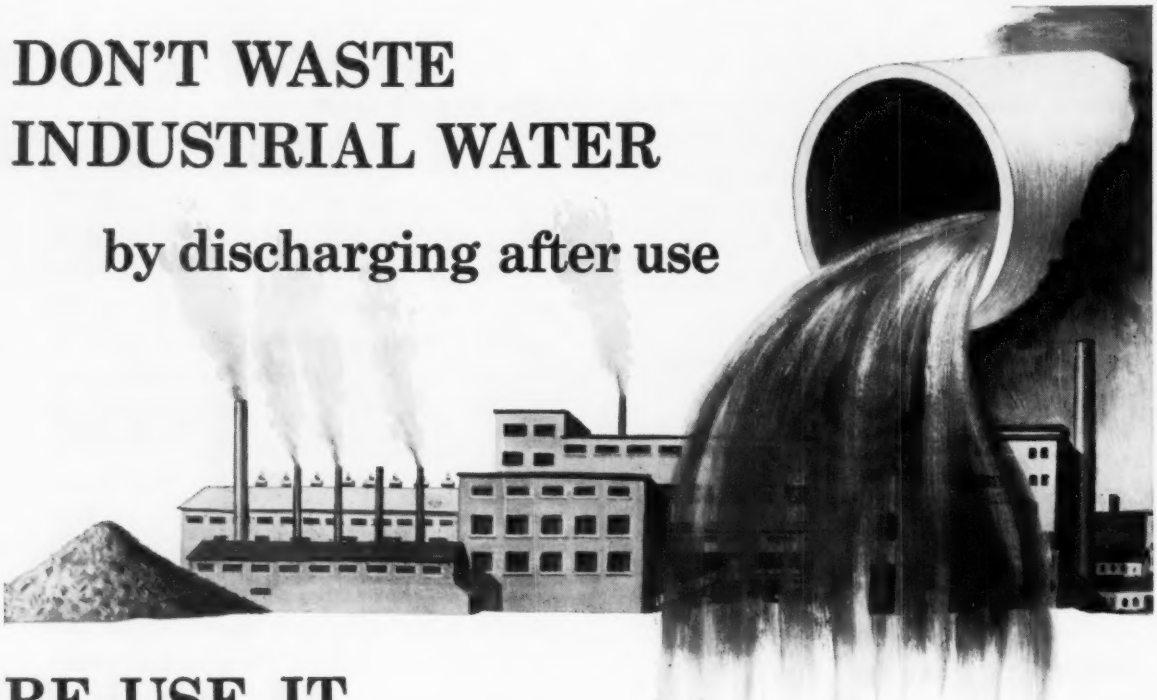
Permission is freely extended to newspapers, groups or individuals to quote or reprint all parts of the present text.

Donald C. McGraw
PRESIDENT

McGRAW-HILL PUBLISHING COMPANY, INC.

DON'T WASTE INDUSTRIAL WATER

by discharging after use



RE-USE IT

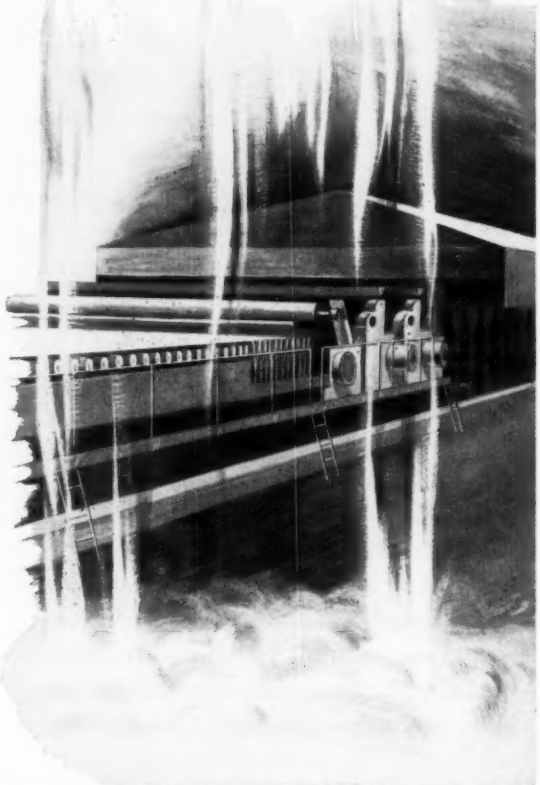
by clarifying with Celite filtration

Recycling your process water instead of discharging it makes good sense in four important ways:

1. It cuts your water costs.
2. It conserves your community's water supply.
3. It helps you meet the high sanitation standards now imposed in many areas.
4. It protects your local rivers and streams from pollution . . . preserves these waterways for recreational purposes.

It also makes good sense to use Celite* diatomite for clarifying this plant waste. Celite filtration removes more suspended solids, including amoebae, algae and most bacteria. It operates at fast flow rates with any conventional pressure filter. It comes in 9 standard grades for precise clarity control. And it is low in cost.

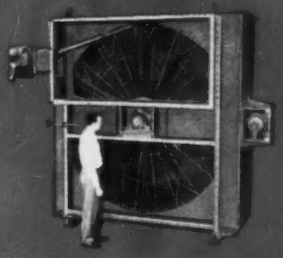
A Celite engineer will be glad to study your water problem and offer recommendations with no obligation. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.



*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products

Johns-Manville CELITE diatomite filter aids

Here's what you can do about the high cost of fuel.



Get the same heat from cheaper fuel with a

LJUNGSTROM® PACKAGE AIR PREHEATER

You can get standard operating temperatures from the cheaper fuels if combustion temperature is high enough. Peat, bagasse or even wood can be used successfully. The Ljungstrom Air Preheater can increase combustion temperature by as much as 300° by recovering heat from the exhaust gas. This reclaimed heat would otherwise go up the stack. All it costs is the price of the preheater—and the Ljungstrom can save enough on fuel to pay for itself in approximately two years.

You can be sure of maximum heat recovery because the Ljungstrom's exclusive rotary heat transfer element picks up the heat from the exhaust and puts it back into the combustion air without passing it through partitions or tube walls. Package design gives you all the advantages and economies of the Ljungstrom in a compact, preassembled unit. The Package Ljungstrom is available in vertical or horizontal models that are readily adaptable to any plant arrangement.

For further information, write today for the free 14-page Package Ljungstrom manual.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

POWELL

world's largest family of valves

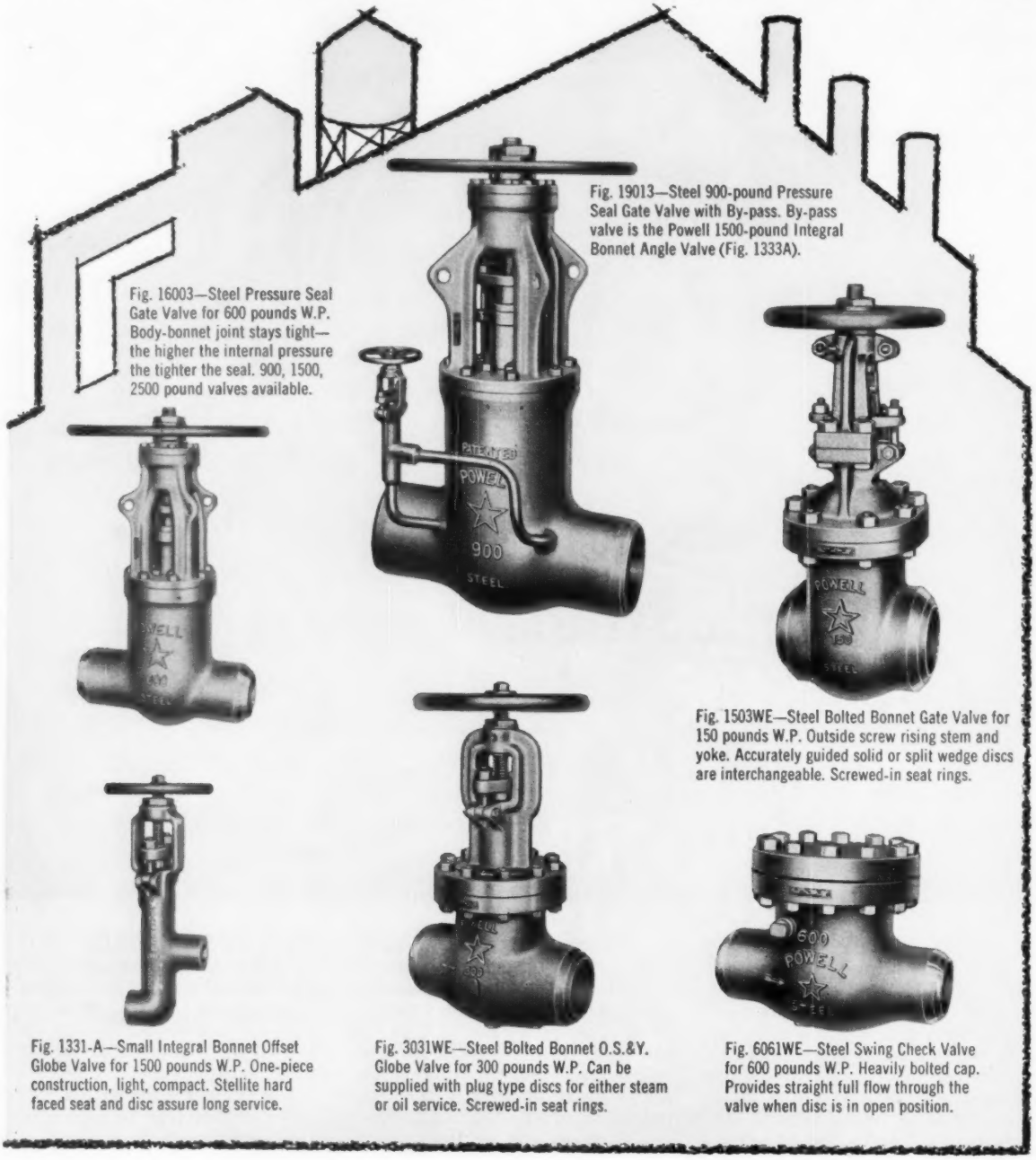


Fig. 19013—Steel 900-pound Pressure Seal Gate Valve with By-pass. By-pass valve is the Powell 1500-pound Integral Bonnet Angle Valve (Fig. 1333A).

Fig. 16003—Steel Pressure Seal Gate Valve for 600 pounds W.P. Body-bonnet joint stays tight—the higher the internal pressure the tighter the seal. 900, 1500, 2500 pound valves available.

Fig. 1503WE—Steel Bolted Bonnet Gate Valve for 150 pounds W.P. Outside screw rising stem and yoke. Accurately guided solid or split wedge discs are interchangeable. Screwed-in seat rings.

Fig. 1331-A—Small Integral Bonnet Offset Globe Valve for 1500 pounds W.P. One-piece construction, light, compact. Stellite hard faced seat and disc assure long service.

Fig. 3031WE—Steel Bolted Bonnet O.S.&Y. Globe Valve for 300 pounds W.P. Can be supplied with plug type discs for either steam or oil service. Screwed-in seat rings.

Fig. 6061WE—Steel Swing Check Valve for 600 pounds W.P. Heavily bolted cap. Provides straight full flow through the valve when disc is in open position.

For every flow control problem Powell offers more kinds or types, available in the largest variety of metals and alloys to handle every flow control requirement. Powell distributors are located in all principal cities and maintain inventories to fill almost any need. For special engineering problems, write direct to:

THE WM. POWELL COMPANY • *Dependable Valves Since 1846* • **Cincinnati 22, Ohio**

Keep yourself up to date . . .

To get more info on new equipment or FREE copies of latest bulletins

follow these easy steps

Preceding pages tell you what's new in plant equipment. Each item is numbered. For more details on any item, write its number here →

New free bulletins are listed and numbered, beginning on back of this page. To order those you want, write POWER item number here — do not use manufacturer's bulletin number. →

Put 2¢ stamp on self-addressed card and mail it to us. We'll pass along your request to the various companies, they'll send the info

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before December 1, 1958. Void after this date. 8/58

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before December 1, 1958. Void after this date. 8/58

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

I want details on these New Products:

☐ ☐ ☐ ☐ ☐ ☐

Send me these FREE Bulletins:

☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐

Please use before December 1, 1958. Void after this date. 8/58

My Name .....
Please print

Home Address .....

City & State .....

Title .....

Company .....

Power a McGraw-Hill Publication

This Month's FREE Literature

PLACE 3c STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 3c STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

PLACE 3c STAMP HERE

Power
Reader Service Department
330 West 42nd Street
New York 36, N. Y.

BOILER ACCESSORIES

1 **Dust-collection system** which collects five tons per hr is described in 8-p bulletin. Booklet covers first- and second-stage units—48 cyclones and two electric precipitators. Buell Engineering Co, Inc, 123 William St, New York, N. Y.

2 **Wet-type dust collector** is discussed in 12-p bulletin 581. Unit works by centrifugal and impingement action. Dust Suppression & Engineering Co, 120 S Broadway, Box 67, Lake Orion, Mich.

3 **Antifoams** to control foaming and carryover in steam boilers are subject of 4-p brochure HSP-905. Includes case histories. Hagan Chemicals & Controls, Inc, Hagan Bldg, Pittsburgh 30, Pa.

4 **Mechanical draft fans** with airfoil blades are topic of 10-p catalog 1321. Includes installation photos, data for three types. Westinghouse Electric Corp, Sturtevant Div, 200 Readville St, Hyde Pk, Boston 36, Mass.

ELECTRICAL EQUIPMENT

5 **Stack-rack capacitor equipments** are described in 8-p bulletin GEA-6796. Contains selection, application, installation info; diagrams and tables. General Electric Co, Schenectady 5, N. Y.

6 **Aluminum electrical conductor** engineering data is contained in 88-p book. Lists 4000 sag and tension charts for most types of covered and bare aluminum. Includes a desk-top glossary of conductors. Aluminum Co of America, 1501 Alcoa Bldg, Pittsburgh 19, Pa.

7 **Tube-type motors** with capsule-mounted split-sleeve bearings are covered in 8-p bulletin 51B8991. Describes units from 40 hp at 600 rpm to 800 hp at 3000 rpm; contains photos, diagrams. Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

MAINTENANCE EQUIPMENT

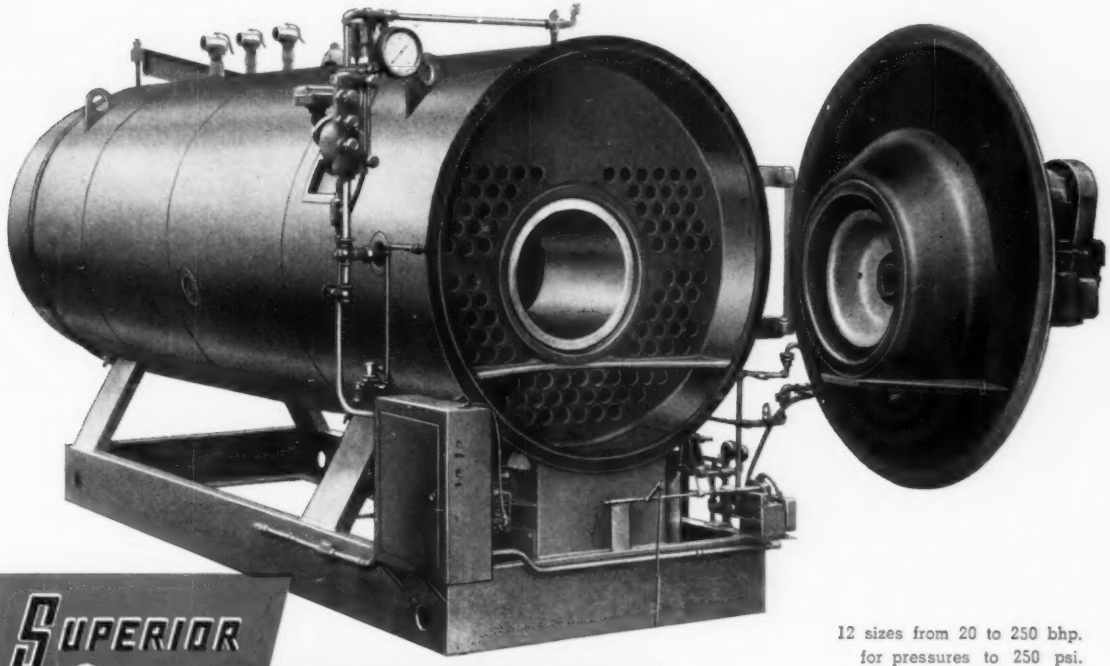
8 **Storage tanks** are described in 36-p catalog 58G. Covers all types of storage systems and plate-fabrication info. Hammond Iron Works, 744 Broad St, Newark 2, N. J.

9 **Work-driver unit** is subject of 12-p bulletin D-57. Includes specs and diagrams for adapter-plate and direct-mounting types. Seneca Falls Machine Co, 13 Fyfe Bldg, Seneca Falls, N. Y.

10 **How to strip paint** is discussed in 8-p booklet F7893. Describes types of strippers, various working methods. Oakite Products, Inc, 123 Rector St, New York 6, N. Y.

(*Continued on page* 180)

SO EASY TO MAINTAIN ITS NEW EFFICIENCY



SUPERIOR "COMPACT"

12 sizes from 20 to 250 bhp. for pressures to 250 psi. or for hot water. Fully automatic operation firing oil or gas or both. Before you buy or specify any packaged boiler, get the details in Bulletin 1000-C

all the big boiler features you want combined with accessibility and easy maintenance

With a full 5 sq. ft. of heating surface per bhp., 4-pass, down-draft design, and built-in induced draft, the Superior COMPACT is a highly efficient and dependable package. Its efficiency, guaranteed by factory-fire-test of every unit, insures years of economical performance; for the Superior COMPACT is planned for the easy maintenance which sustains high efficiency.

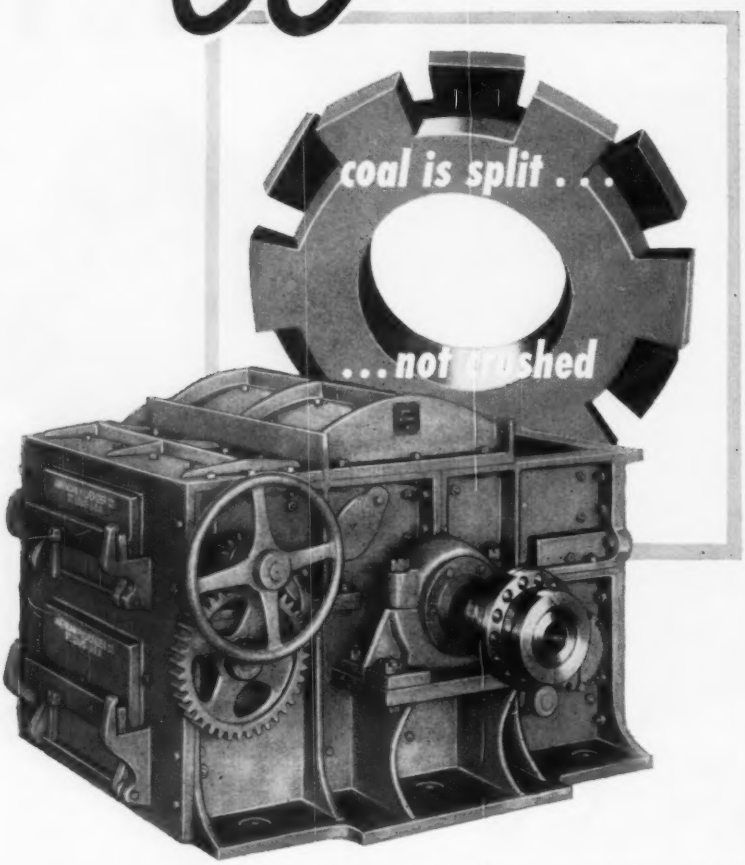
Front doors are hinged, and rear doors hinged or davited to simplify inspection and cleaning. But note that no belts or mechanical components are located inside the front door where they would be subject to the heat of the fire. All units firing #4, #5 and #6 oil are equipped with dependable Superior Rotary Burners. High in the shell, and protected by the tubes of the fourth pass, the furnace is away from the "danger zone" eliminating the possibility of bagging or blistering.

Specialists in PACKAGED BOILERS... exclusively

SUPERIOR COMBUSTION INDUSTRIES INC.
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR PACKAGED BOILERS

PERFORMANCE-PROVED FOR 50 YEARS



American Rolling Ring Coal Crusher

In 1908 American Pulverizer patented the rolling ring principle of coal reduction. Today there are thousands of American Coal Crushers in operation ranging in size from Sample Crushers to Crushers having a capacity of 800 tons per hour.

American manufactures reduction equipment exclusively, backed by a half century of experience in the production of coal reduction equipment. Although improvements have been consistently made in American Crushers, the rolling ring principle still remains the most efficient method of coal reduction. This fact is **performance-proved** by hundreds of "cost of operations" reports from customers of American Rolling Ring Coal Crushers. May we have our engineers analyze your reduction problem?

Complete Literature Available. State your tonnage requirements.

"When you figure costs—the best results come from American Rolling Ring Coal Crushers."

American PULVERIZER COMPANY
ORIGINATORS AND MANUFACTURERS OF RING CRUSHERS AND PULVERIZERS
1349 MACKLIND AVE. SAINT LOUIS 10, MO.

Equipment news

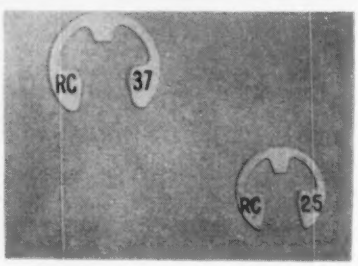
Begins on page 148

Electronic fish control

814 • Unit is designed to electrically guide fish to predetermined areas, such as fish ladders, elevators or traps, and away from tail races. The control unit operates without moving parts, and adjustments on the panel can be made to compensate for water velocity, conductivity and size and type of fish.

Other models prevent fish from entering hydro plants, industrial pumping installations, condensing water intakes.—*Electric Fish Screen Co, 1130 N Poinsettia Place, Hollywood 46, Calif.*

For more details on these items, use post cards p. 161. Identify your request with item number.



Size-identified rings

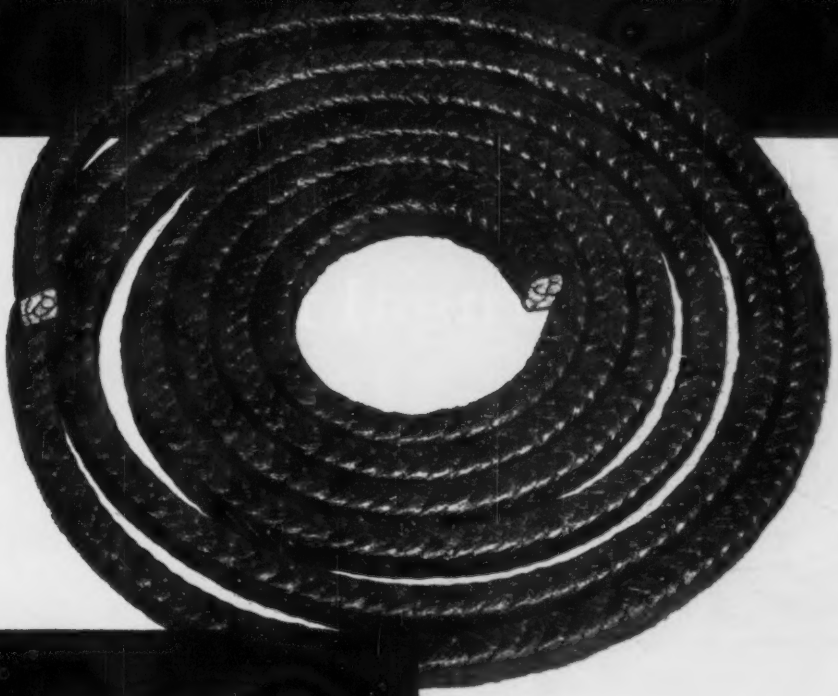
815 • Retaining ring size in millimeters is engraved on each piece. The clips have a special tapered design for lower stress at the mid-section. They are available stacked on rods for automatic assembly operations.—*Roto-Clip Co, 114 Allen Blvd, Farmingdale, N. Y.*

Multiservice grease

816 • One grade of grease can be used in many different applications

(*Continued on page* 167)

A PACKING ADAPTABLE TO MANY USES



905

BRAIDED AND TWISTED ASBESTOS PACKING

Anchor 905 is a square braided asbestos packing with an Ankoprene core and binder throughout the braid. The thorough coating of the asbestos fibers with Ankoprene compound protects the packing body against destruction from certain acid and alkali solutions.

Anchor 905 is used on rods handling gasoline, butane, propane or any of the petroleum-derived hydrocarbon solvents or for use on oil services where the temperature does not exceed 450° F. Finds many uses in chemical plants, gas manufacturing plants, etc. This packing has widespread use today and in it you will find many superior advantages toward better packing service.

In sizes ¼" and up. For full details write today.

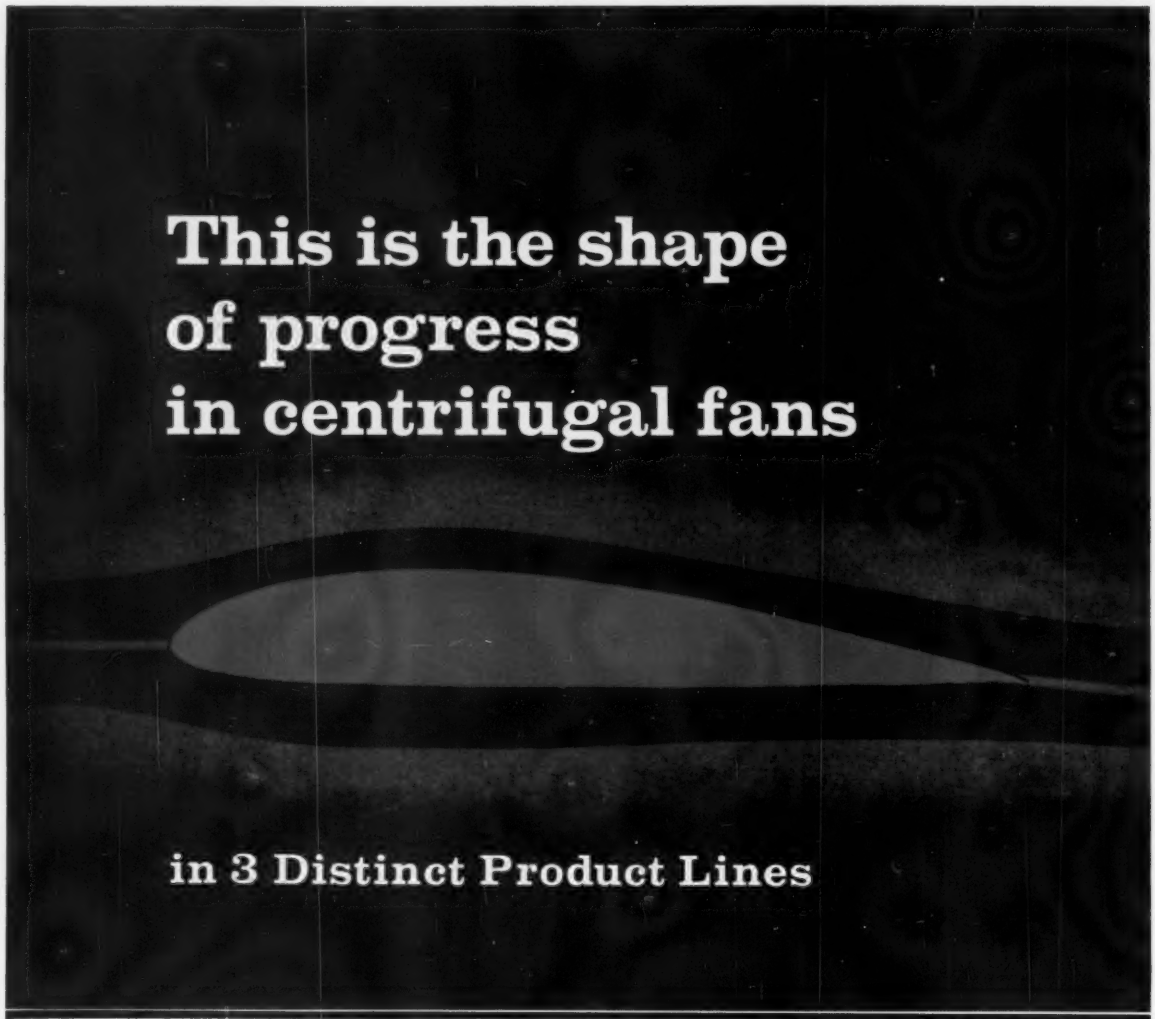
BRANCHES

BOSTON, MASS.
CHICAGO, ILL.
DETROIT, MICH.
LOS ANGELES, CAL.
NEW ORLEANS, LA.
NEW YORK, N. Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
ST. LOUIS, MO.

THE ANCHOR PACKING COMPANY

GENERAL OFFICES . . PHILADELPHIA, PENNSYLVANIA
FACTORIES . . MANHEIM, PA., ELKHART, IND., MONTREAL, CAN.

● *FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE*



FULL RANGE APPLICATION	COMBUSTION AIR FOR CONVENTIONAL BOILERS Series 4000	HIGH PRESSURE AIR FOR PRESSURIZED FURNACE BOILERS Series 2200	PRIMARY AIR Series 2100
Volumes (cfm)	10,000 to 700,000	25,000 to 350,000	6,000 to 50,000
Pressures ("H_2O)	Up to 45"	45" to 90"	Up to 65"

Westinghouse Airfoil* blading offers . . .

Lowest Operating Cost
Highest mechanical efficiency ever: over 92%.

Quieter Operation
Perceptibly quieter in actual operation.

Stable Pressure
Ideally suited to single and parallel operation.

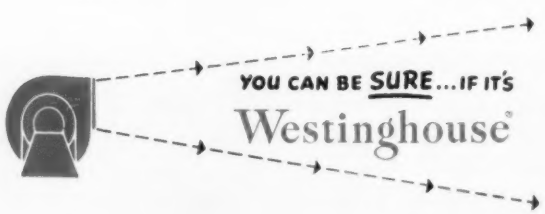
Non-Overloading Power Feature
True self-limiting horsepower characteristic.

Optimum Performance
Sized for specific customer requirements.

Inlet Air Spin Control
Efficient at part loads. Saves power, saves dollars.

Call your nearest Sturtevant Division Sales Engineer, or write Westinghouse Electric Corporation, Dept. H-17, Hyde Park, Boston 36, Massachusetts.

*Trade-Mark J-80669



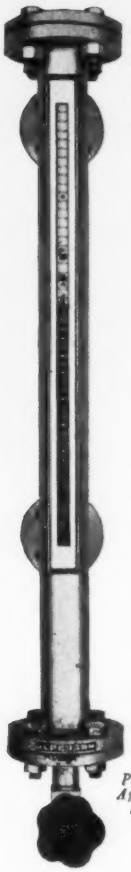
Announcing

the New

Jerguson

MAGNETIC GAGE

For Liquid Levels



An important advancement in liquid level observation for plants with dangerous explosive or inflammable conditions.

Safety design seals against escaping gases.

Measuring mechanism in stainless steel chamber.

Scale mounted outside chamber; magnetically actuated through chamber wall.

Distinct, accurate level shown in red contrasted with silver above.

Job designed, correlating pressure, temperature, and specific gravity.

For pressures up to 2500 lbs. @ 600° F.

Patent Applied For

Can also be used for interface indication.

Write now for engineering sheet on Jerguson Magnetic Gages.

JERGUSON

Gages and Valves for the Observation of Liquids and Levels

JERGUSON GAGE & VALVE COMPANY

100 Adams Street, Burlington, Mass.

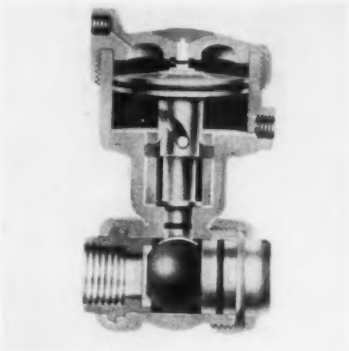
Offices in Major Cities

In Canada: Peacock Bros. Ltd.

Equipment news

Begins on page 148

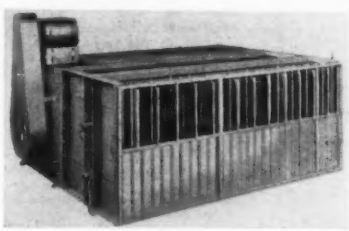
in place of a variety of special-purpose greases, according to manufacturer. The calcium-EP-complex lube is said to withstand extreme pressures and to have long service life. It is water-resistant and maintains chemical stability in temperatures from –15 to +300 F.—*Socony Mobil Oil Co, Inc, 150 E 42nd St, New York 17, N. Y.*



Valve operator

817 • Low-cost all-plastic valve operator is said to be completely corrosion resistant. Unit was developed for hydropneumatic servo or remote systems as well as enclosed or automatic systems. It has a safety factor of 5 to 1 and takes temperatures to 300 F, according to maker.—*Tapered Air Products, Chemtrol Div, 10890 Stanford Ave, Lynwood, Calif.*

For more details on these items, use post cards p. 161. Identify your request with item number.



Heating, ventilating unit

818 • Units come in 11 sizes for requirements from 600 to 66,000 cfm. Flexible design is said to permit a wide selection of combinations and arrangements—units, coils and accessories can be built up in any sequence required to meet the needs of a specific job, maker states.

Unit pictured gives complete coverage of central-station heating and ventilating requirements, and indi-

Westinghouse airfoil fans serve these leading utilities

COMBUSTION AIR FOR CONVENTIONAL BOILERS

Consolidated Edison
Ohio Valley Electric Corp.
Duke Power Co.
Duquesne Light Co.
Pennsylvania Electric Corp.
Tennessee Valley Authority
Philadelphia Electric Co.
Commonwealth Edison
Dayton Power & Light
Cleveland Electric Illuminating Co.

HIGH-PRESSURE AIR FOR PRESSURIZED FURNACE BOILERS

Ohio Power Co.
United Illuminating Co.
Detroit Edison Co.
Appalachian Electric & Power Co.
Indiana & Michigan Electric Co.
Atlantic City Electric Co.
Missouri Public Service
Memphis Light & Power Co.

PRIMARY AIR

Detroit Edison
Consolidated Edison
Toledo Edison
Ohio Power Co.
New England Power
Virginia Electric & Power
Delaware Power & Light
Public Service Electric & Gas

J-80675

YOU CAN BE SURE...IF IT'S Westinghouse

Diamond INDUSTRIAL TELEVISION for the TOUGH JOBS

Diamond "Utiliscope" has extremely long life

Here is a rugged and durable television system built especially for industrial use. It gives years of satisfactory service under the most difficult conditions industry has to offer . . . and with minimum attention. Diamond television systems installed as long ago as 1947 are still in operation.

Have you explored the possibilities of the Diamond "Utiliscope" for your remote viewing problems? It is saving money and improving operations in many plants. The coupon below will bring full information.

REPRESENTATIVE APPLICATIONS

Boiler Furnace Interiors
•
Annealing Furnace Interiors
•
Steel Billet Pouring
•
Open Hearth Furnace Interiors
•
Cement Kiln Interiors
•
Remote Mining Machinery
•
Slab Furnace Interiors

8120

Diamond

FIRST IN INDUSTRIAL TELEVISION

•

SINCE 1946, DIAMOND HAS MANUFACTURED QUALITY TELEVISION FOR INDUSTRY

DIAMOND POWER SPECIALTY CORP.
ELECTRONICS DIVISION, P.O. BOX 58Z
LANCASTER, OHIO

Please send me without obligation a copy of bulletin showing how Diamond Industrial Television will help me reduce costs and improve operations.

Name_____

Title_____

Company_____

Address_____

Equipment news

Begins on page 148

vidual zone control of temperature from the single central unit.—*American Blower Div of American Standard, Detroit 32, Mich.*

Replaceable cleats

819 • Rubber cleats can be applied to belt on the job and equipment returned to service within a few hours, according to manufacturer.

Underlying each cleat is a thin strip of semicured rubber which reacts when a vulcanizing fluid is applied and bonds with rubber-covered, fabric or friction-surface conveyor belting.—*Flexible Steel Lacing Co, 4607 Lexington St, Chicago 44, Ill.*

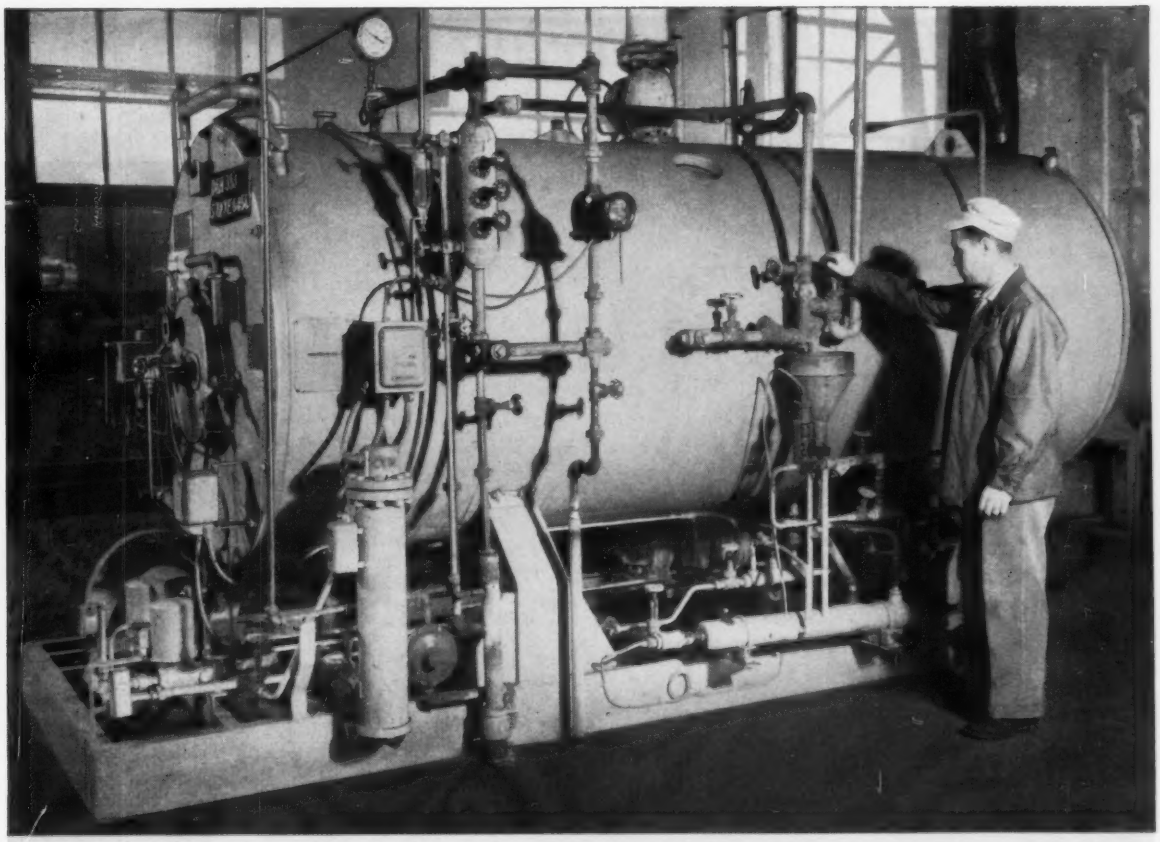
For more details on these items, use post cards p. 161. Identify your request with item number.

Insulating-finishing cement

820 • White insulating-finishing cement is said to provide 30% more dry coverage with little shrinkage. Field tests of the spun-mineral-wool material show that 100 lb will cover an area of 72 sq ft with a half-inch layer, according to manufacturer.

Cement insulates and finishes in a single coat, whether applied directly

(*Continued on page* 171)



125 HP AMESTEAM GENERATOR Installation at Delaware and Hudson RR Diesel Shops at Binghamton, N.Y.

D & H R R ESTIMATES $30,000 ANNUAL SAVINGS WITH FOUR AMESTEAM GENERATOR AUTOMATIC BOILERS

"... we estimate $10,500 annual savings ... more than 44 percent return on our investment ... with the 125 HP AMESTEAM GENERATOR installation at our Binghamton diesel shops alone ..."

And that's only *one* of four AMESTEAM GENERATOR installations mentioned in a letter to us from Mr. P. O. Ferris, Chief Engineer of the Delaware and Hudson Railroad. Mr. Ferris goes on to say ...

"At the present time we have installed these generators at the following locations, at the estimated total annual savings of $29,899 shown:

LOCATION	H. P.	Estimated Annual Savings	Percent Return On Investment
Rouses Point	125	$ 8,350.00	33.2
Whitehall	200	6,841.00	22.3
Mechanicville	80	4,208.00	19.7
Binghamton	125	10,500.00	44.2
ESTIMATED TOTAL ANNUAL SAVINGS		$29,899.00	

What more can we add to this factual testimonial of satisfaction from the Delaware and Hudson Railroad? Only this: we have on file similar reports from hundreds of satisfied users of AMESTEAM GENERATORS. Among leading railroads alone, we number 40 satisfied customers ... using 194 of our economical, dependable "package type" boilers.

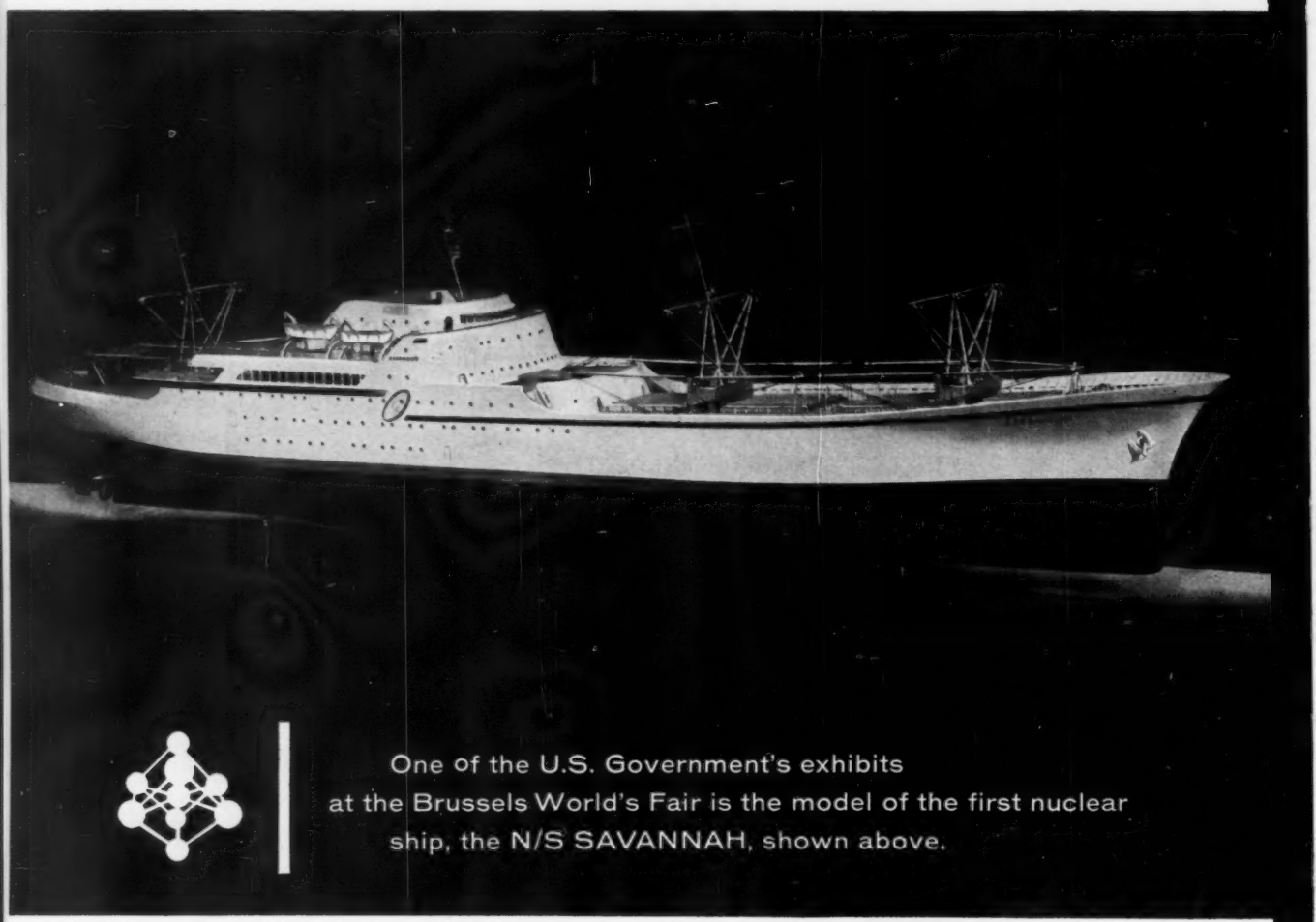
This all adds up to *your* assurance of savings and satisfaction with AMESTEAM GENERATORS.

AMES IRON WORKS INC.
BOX H-88 OSWEGO, N. Y.

WHAT'S YOUR STEAM PROBLEM?

For high-quality automatic package boilers, 10 to 600 HP, write us today for the name of your AMESTEAM GENERATOR Representative and our latest catalog.

Creative Engineering by DE LAVAL



One of the U.S. Government's exhibits at the Brussels World's Fair is the model of the first nuclear ship, the N/S SAVANNAH, shown above.

The De Laval Steam Turbine Company is proud to play an important part in the design and construction of this 22,000 shaft horsepower vessel, the keel of which was laid on May 22, 1958, Maritime Day, at the New York Shipbuilding Corp. in Camden, New Jersey.

Under the joint sponsorship of the Atomic Energy Commission and the U. S. Maritime Administration, major contributions to the design and construction of the vessel and its machinery are being made by:

- *George G. Sharp, Inc., naval architects, designers of the vessel*
- *Babcock & Wilcox Company, designers and builders of the pressurized water reactor and its accessories*
- *New York Shipbuilding Corp., Camden, N. J., builders of the vessel*
- *De Laval Steam Turbine Company, designers and builders of the main propulsion machinery, other engine room auxiliaries; coordinators of all engine room equipment.*

We are particularly happy to serve in connection with this project of international importance. De Laval has often performed other important services as complete engineering coordinators, and is fully prepared to undertake similar assignments.

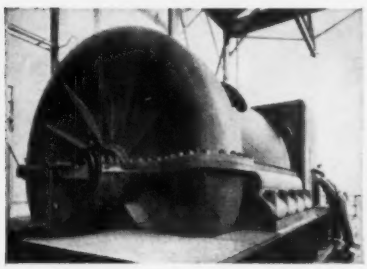
DE LAVAL *Steam Turbine Company*

815 Nottingham Way, Trenton 2, New Jersey

More Ways

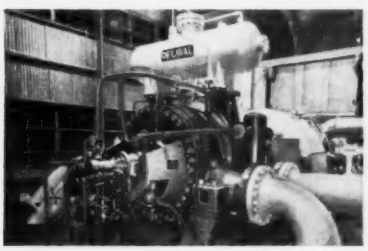
DE LAVAL

Creative Engineering Serves Industry



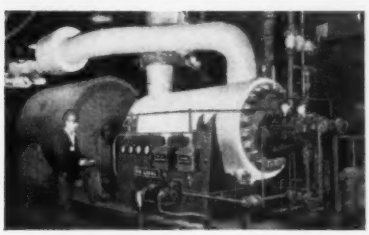
Centrifugal Compressors for Refineries

Shown here is a De Laval 10,200 H.P. turbine-driven main air blower handling 83,000 cubic feet per minute at the Ashland Oil & Refining Co., Ashland, Ky.



Extra Flexibility for Gas Pipelines

Creative engineering developed new De Laval Series-Parallel centrifugal compressors to meet booster stations' demand for exceptional flexibility.



Rugged Feed Pumps for Public Utilities

De Laval couples *creative engineering* and precision manufacturing methods to produce multi-stage centrifugal pumps for boiler feed service—built to handle pressures up to 5,500 pounds. This is an 11-stage unit in the Astoria Station of Con Edison.

Investigate the advantages of De Laval's *creative engineering* in refinery and pipeline compressors, steel mill blowers, ship propulsion units and marine auxiliaries, turbine generators, IMO pumps, worm gearing, planetary gearing and diesel engine turbochargers.

Send today for 48-page booklet—"Men, Machines and Materials at DE LAVAL."

De Laval Steam Turbine Company
815 Nottingham Way, Trenton 2, New Jersey

Equipment news

Begins on page 148

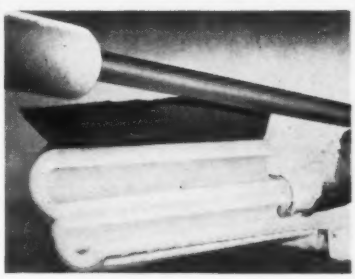
to such irregular hot surfaces as valves and fittings or over other insulations. — *Baldwin-Hill Co, 500 Breunig Ave, Trenton 2, N. J.*

Steam, heating boiler

821 • Unit is compactly designed, needs less than one-third of the floor space usually required. Test units have reduced fuel operating costs one-third, maintenance upkeep 50%, according to manufacturer.

Vertical arrangement of boiler's tubes provides for rapid water circulation and high heat transfer, said to result in an 80% thermal efficiency. —*Hercules Power Equipment Co, Box 49724, Barrington Sta, Los Angeles 49, Calif.*

For more details on these items, use post cards p. 161. Identify your request with item number.

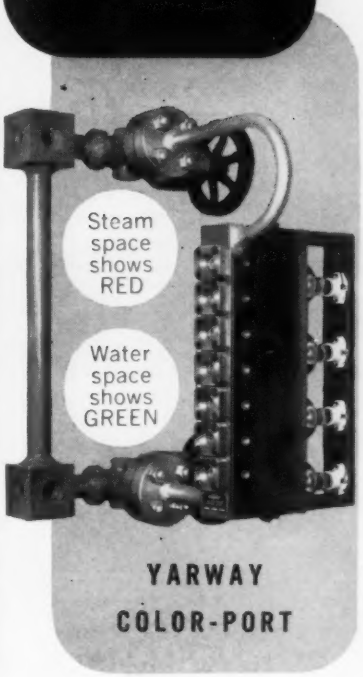


Glass fiber pipe covering

822 • Lightweight pipe covering is designed for insulating hot- and cold-water piping, low-pressure steam lines and refrigerant lines. For sub-zero to 350 F applications the covering features long life, because the glass fibers do not shrink, rot, buckle, burn or support combustion.

The insulation comes in hinged 3-ft sections, in wall thicknesses for

newest HIGH pressure water gage offers LOW, LOW upkeep



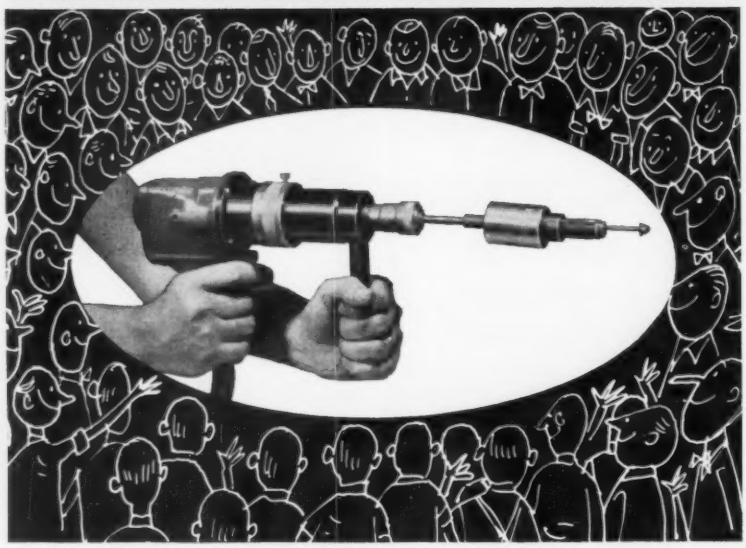
This newest Yarway boiler water gage for pressures to 3000 psi features maintenance as easy as A-B-C—plus **brilliant** red and green water level readings. Write for Bulletin WG-1814. YARNALL-WARING Co., 100 Mermaid Ave., Philadelphia 18, Pa.

Branches in all principal cities.

go YARWAY with confidence

The New ELLIOTT Air Magnetic Control...

for tube expanding in hazardous locations



popular everywhere!

here's why:

- faster-rolling
- higher maximum torque
- simpler to use and maintain
- and costs are low

These advantages have made the Elliott air magnetic control the popular choice of operators in oil refineries, chemical plants, and other industries. Its secret is a uniquely-engineered design which uses a new concept of torque control. Two powerful permanent magnets give instantaneous engagement and disengagement between air motor driver and driven expander. Calibrating dial permits exact settings for torque control.

Four types of expanders available for tubes ¼ in. through 3 in. *Write for data today.*

ELLIOTT Company

LAGONDA PLANT, SPRINGFIELD, OHIO

Headquarters for Tube Cleaners and Expanders

Y8-3

Equipment news

Begins on page 148

iron pipe from ½- to 12-in. and for copper tubing from ½- to 3-in. OD. —*Ehret Magnesia Mfg Co, Valley Forge, Pa.*

Heat-exchanger tube

823 • Impervious graphite tube with internal low fins is said to more than double the inner surface area of shell and tube heat exchangers. The 23 fins, each 3/16-in. high, increase inner surface to 2.6 times that of a plain ⅞-in. ID tube.

Fins twist helically through the length of the tube, providing turbulent flow at right angles to longitudinal axis, accentuating the difference between streamline and turbulent flow, and increasing the heat-transfer coefficient as fluid velocities increase. —*National Carbon Co, Div of Union Carbide Corp, 30 E 42nd St, New York 17, N. Y.*

For more details on these items, use post cards p. 161. Identify your request with item number.

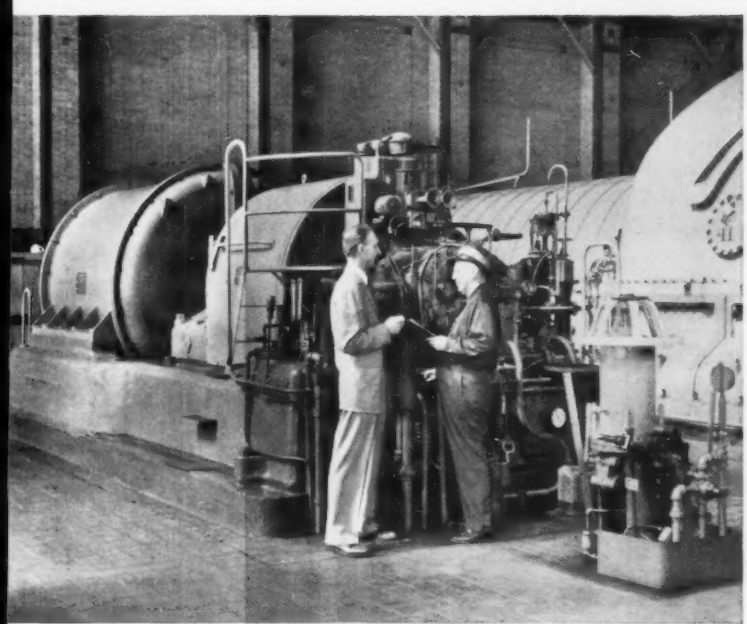
Double-duty belt

824 • Unit was designed to absorb and distribute shock. The belt can be turned over after first carrying side is no longer satisfactory. It is medium weight and is said to be extremely flexible with a high impact resistance for use over smaller-than-usual pulleys on short center hauls.

Belt is made of 2- or 3-ply cotton-nylon fabric with a skim coat of rubber between plies. An envelope ply of double-skimmed extra-heavy open-weave all-nylon fabric entirely surrounds the core and acts as a cushion. Top and bottom covers are made of high-quality abrasion-resistant rubber 3/32-in. thick.—*Quaker Rubber Div, H K Porter Co, Inc, Tacony & Comly Sts, Philadelphia 24, Pa.*

Report from Wisconsin Electric Power Company

HOW THE ONLY OIL WITH LIFE-OF-TURBINE GUARANTEE IS DOING AFTER 27 YEARS



Standard Oil's Robert A. Guis and Lakeside Station superintendent, C. E. Thielman, inspect records of Turbine 12, which has been operating with NONPAREIL Turbine Oil for 27 years. Years of experience providing technical service and an engineering degree qualify Bob Guis for work with utilities on turbine lubrication. Bob has an engineering degree from the University of Wisconsin plus 18 years of this kind of work behind him. In addition, he has completed the Standard Oil Sales Engineering School.

Situation: On February 23, 1931, Wisconsin Electric Power started Turbine 12 at its Lakeside Station – a 7,700 kw. General Electric. The 550-gallon turbine oil reservoir was filled with NONPAREIL. A Standard Oil lubrication engineer was there to supervise the fill. After 30 days a framed certificate was furnished the utility. This certificate guaranteed that the NONPAREIL Turbine Oil would never exceed a level of acidity of 0.15 mg. KOH/g. for the life of the turbine.

What has happened: Analyses of oil samples have been made at regular intervals since the start-up date. The acidity level of the oil now is the same as the day it went into service –0.06 mg. of KOH per gram of oil. In the 27 years since NONPAREIL Turbine Oil was installed, Wisconsin Electric Power has added steadily to its generating capacity. NONPAREIL Turbine Oil has been installed in all turbines.

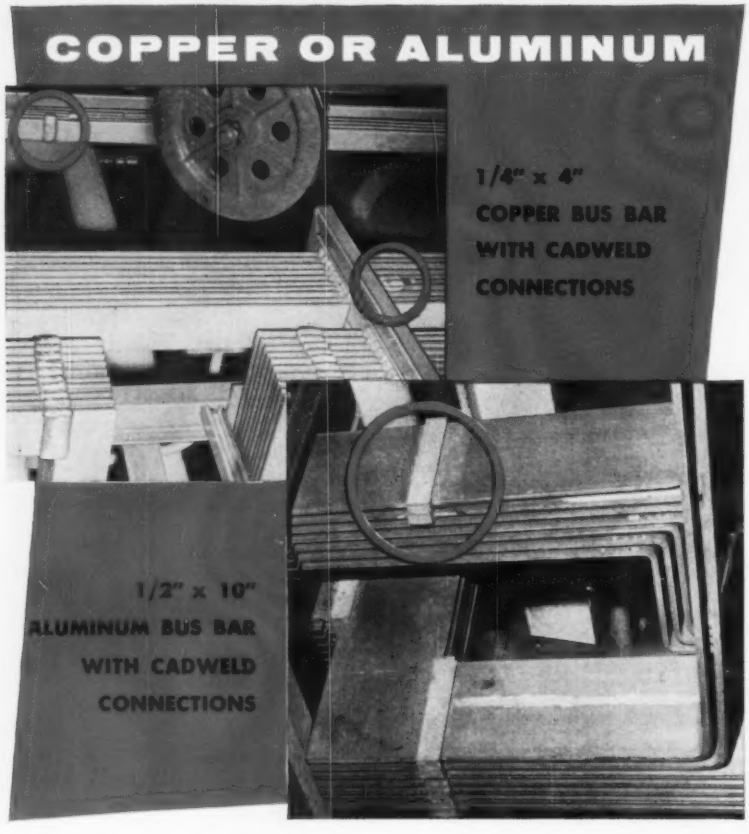
What to do: Get more information about NONPAREIL from your nearby Standard Oil industrial lubrication specialist in any of the 15 Midwest and Rocky Mountain states. Or write **Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.**

Quick facts about
NONPAREIL Turbine Oil

- Will not permit formation of harmful acids
- Will not permit formation of sludge or oil varnish
- Will maintain good demulsibility or water separating characteristics
- Has high resistance to foaming
- Contains adequate rust inhibitor

You expect more from STANDARD and get it!

BUS BAR CONNECTIONS



Cadweld Connections on Copper or Aluminum Bus Bar Offer 5 Major Advantages

1. Random length bus can be used — reduces original material cost.
2. Weld size permits stacking of multiple runs, while maintaining proper spacing.
3. Reduced labor — individual fabrication of multiple runs permits easy handling of lightweight single sections.
4. Connections are permanent — not subject to loosening, corrosion or overload damage.
5. Newest CADWELD A-22 Aluminum welding alloy permits welding of transition joints of copper to aluminum.

CADWELD®

Erico Products, Inc.

2070 E. 61st Place Cleveland 3, Ohio

IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario

My biggest boner

In the early days of electrification we had a tough condition where each subdivision of the plant had a separate 33,000-volt supply line. Pleas to the power people to install a tie line at our expense proved futile.

Since the ties would be paid for by the plant, we argued that we might as well do it ourselves. But we'd be at the mercy of forest fires, poor lightning protection and the trigger-happy individuals who roamed the forest with high-powered rifles and used an occasional insulator for a target.

No. 1 grade, western cedar poles were purchased and the initial line built to meet all code requirements. Double crossarms and insulators at all railway and street crossings, plus a woven (link) network was slung under the line where it crossed the schoolyard.

Came St Patrick's Day, and we were scheduled to try out the new tie line. With plenty of "brass" on hand to witness the first of the ties, everything stood still at high noon when the switchover was made. Imagine our chagrin when a terrific explosion was seen in the switchyard as the oil switch was magnetically thrown. A high line fuse had gone, and on no load!

A hurried check of the wood substation tower at the 1-mile distant plant disclosed that we had a dead short circuit or crossover in the last 10 feet of the conductors.

Reason? The transposition had been made *after* the lines were polarized and the required correction had not been made at the other end!

P C ZIEMKE, *Clinton, Tenn.*

A $3,400,000 contract to design and build hydrogen, nitrogen and carbon dioxide producing and purifying units for Navy's Muskogee plant has been awarded to Girdler Construction Div of National Cylinder Gas Co. Plant is world's largest for high-energy boron fuel.

Newly developed electroluminescent indicator should have wide application in automation and process supervising, according to the AIEE.

REASONS WHY ENGINEERS CHOOSE "BUFFALO" PUMPS

Let's think of pumps in terms of hard service on the job — and the reasons why "Buffalo" Pumps deliver maximum efficiency with minimum maintenance for years and years of such service.
Note these rugged construction features of "Buffalo" Full Ball Bearing Single Suction Pumps:

1. Sturdy cast iron bearing stand and casing mounting ring. These components are interchangeable on all size pumps up to and including No. 3. Engineers like this feature, since they often effect economies by standardizing on one line of pumps with varying capacities.

2. Easily-renewable bronze wearing rings protect casing from wear.

3. High efficiency bronze impeller. Enclosed type has liberal openings to handle abrasive solids. Open type, without wearing rings, is optional.

4. Oversize ball bearings running in oil provide rigid support for shaft and impeller.

Add to these the heavy cast iron frame, oversize shaft, extra-deep stuffing box, long-wearing gland with packing furnished — and you have a total of eight superior engineering features built into every "Buffalo" Single Suction Pump.

These plus many more high quality "Buffalo" components provide the sound reasons why engineers look to "Buffalo" Pumps for a long life of efficient, dependable, economical service. For your next heavy-duty pumping job, contact your nearby "Buffalo" Engineering Representative. He will be glad to work with you and help in every way. Or, write us direct for Bulletin 976-E.

"Buffalo" Pumps bring you the famous "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life.

"Buffalo" Single Suction Pump

BUFFALO PUMPS

DIVISION OF BUFFALO FORGE CO., BUFFALO, N. Y.

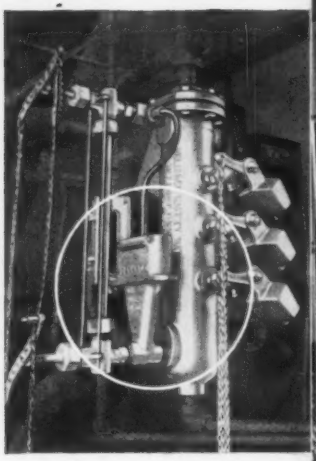
488 Broadway • Buffalo, N. Y.

Canada Pumps, Ltd., Kitchener, Ont.

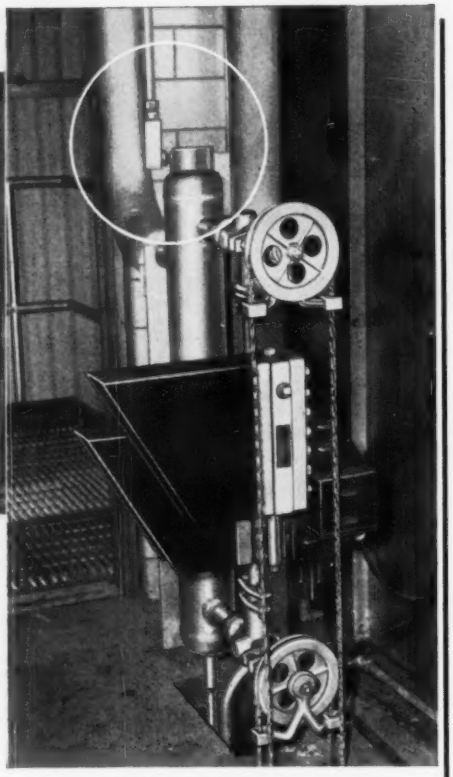
Sales Representatives in all Principal Cities

"Buffalo" PUMPS

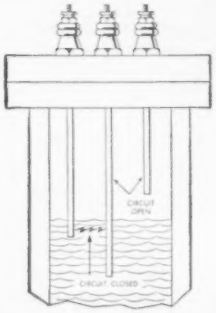
A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID



Simplest type of Levalarm, the EA15, for fuel cut-out or/and low water alarm.



The EA18 Levalarm on this water column provides high and low alarm, fuel cut-out, pump start and pump stop.



Your boiler water "calls the signals" through the Reliance LEVALARM® system

Positive, quick-acting protection for your boiler's safety

Reliance Levalarms (4 models) are designed to give you *fast action* — within a small fraction of an inch of water level variation. From one function (fuel cut-out or low water alarm) to combinations of up to *five* are available through this group of helpful signals and controls — high and low alarms, fuel cut-out, start and stop pump.

Operated by relays and isolated minute transformer-created currents that pass through the boiler water in the column, Levalarms are entirely electrical; they do not depend on vacuum tubes or magnets — have no stuffing boxes or bellows. Unaffected by pressure or temperature. Levalarms are made for every boiler pressure.

Read the full story of Reliance Levalarms in Bulletin D2. Write today.

The Reliance Gauge Column Company • 5902 Carnegie Avenue • Cleveland 3, Ohio

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES

Gas turbine

Continued from page 103

centrifugal type was chosen. The gas compressor can handle more gas than needed for full load. It has a slightly higher pressure ratio than the main air compressor.

The cast-iron casing encloses impellers made of alloy steel and built up of vanes enclosed in hub and cover disks. The impellers mount on a mild-steel shaft and are kept in position by spacer bushings.

Diffusers can be adjusted to give the desired pressure-rise per stage, before being finally locked in place. A gland gas-extraction fan prevents air leaking into the compressor through the labyrinth glands. When burning oil and no gas, this compressor will also supply air to the unit.

Starting motor, of the three-phase slip-ring induction type, develops 142 kw at 1000 rpm. Contactors short-circuit sections of the rotor windings to bring the motor up to speed, about one-third of the unit's running speed.

Being permanently coupled to the generator shaft, the starting motor cannot be disconnected. When the unit runs above starting speed, a small auxiliary motor automatically lifts the motor brushes off the slip rings.

Supports. A single-fabricated bedplate carries the turbine and the bearing pedestal between turbine and air compressor. The pedestal supports the inboard bearings of turbine and compressor and the thrust bearing. Another bedplate carries gearbox, gas compressor, starting motor and generator.

The air compressor's inboard feet rest on the turbine bedplate and the outboard feet on the combined bedplate. Center supports on each side of the air compressor rest on separate small bedplates attachd to the foundation steelwork.

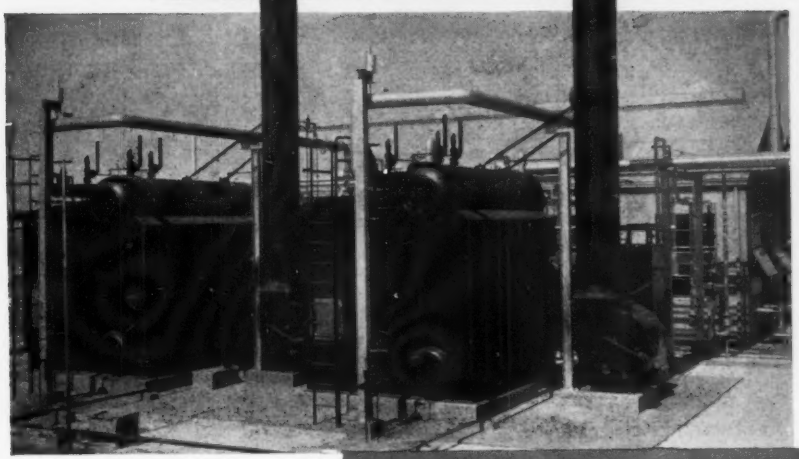
The inboard feet of the turbine are fixed on the bedplate but the side and outboard feet allow the cylinder to expand—the rotor moving in the same direction. Keys keep both turbine and compressor cylinders in line.

Compressor air and turbine gas flow in the same direction to help compensate for the thrust. A rigid coupling connects turbine and compressor

Vogt

Package

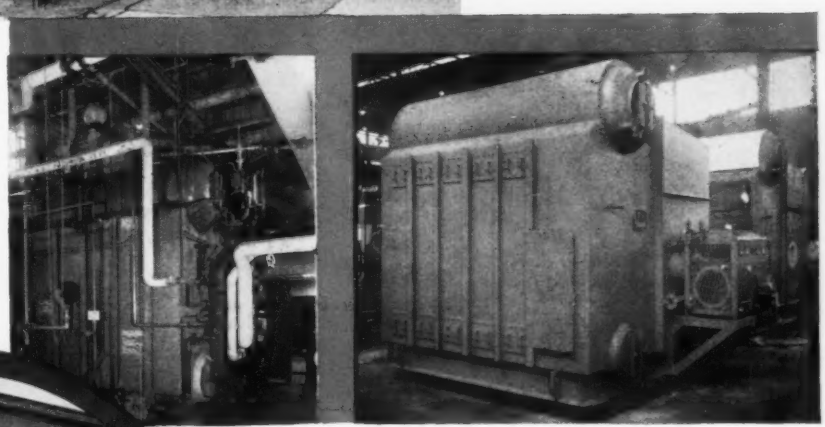
STEAM BOILERS *give* versatility with economy

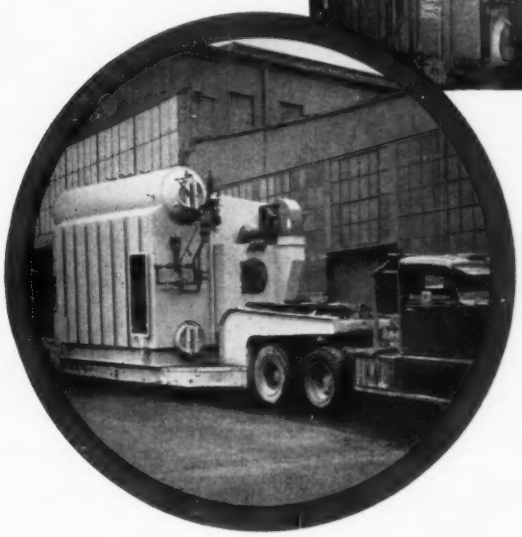


Above: Two units serve a gas pipeline company.

Left: Installation in fibre box-board plant.

Right: Unit for a leading soap manufacturer.





Enroute to an office building.

FOR POWER, PROCESS OR HEATING

Available in capacities from 10,000 to 50,000 pounds steam per hour in three standard pressures of 175, 250 and 375 pounds per square inch gage, factory assembled.

Write for Bulletin PSG-2, 24A-BP

HENRY VOGT MACHINE COMPANY, Louisville, Ky.

SALES OFFICES: New York, Chicago, Cleveland, Dallas, Camden, N. J., St. Louis, Charleston, W. Va., Cincinnati.

OTHER VOGT PRODUCTS:

DROP FORGED STEEL VALVES, FITTINGS, FLANGES AND UNIONS
PETROLEUM REFINERY AND CHEMICAL PLANT EQUIPMENT
HEAT EXCHANGERS • ICE MAKING & REFRIGERATING EQUIPMENT

Quiet, Efficient, Convenient

Ideal for Hospitals, Hotels, Apartments, and Industries where noise is objectionable.

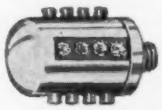
Rotojet Electric Tube Cleaner thoroughly cleans straight tubes from 25/32" to 4" I.D. in boilers, condensers, evaporators, and heat exchangers so quietly that it can be operated without disturbing anyone.

This self-contained unit comprises a powerful motor, rotatably mounted on a stand, a required length of heavy duty flexible shaft, a 20 ft. cable, and a selection of heads, brushes, drills, and scrapers to meet any cleaning need. The motor swivels and rotates so that tubes on top, bottom, and sides can be cleaned without moving the unit. A few of the many types of heads available are shown below.

Bulletin 107 gives full details of this quiet, efficient, convenient tube cleaner. Send for it now.

Rotojet Electric Tube Cleaner with swing-frame head.

4-way drill and universal coupling.



Expanding wire brush.

ELLIOTT COMPANY – ROTO PLANT
Tube Cleaner Specialists Since 1910
153 Sussex Avenue, Newark, N. J.

Gas turbine

Continued from page 176

shafts. Flexible gear type couplings connect the compressor shaft and gear-pinion shaft, the low-speed gear-wheel shaft and starting-motor shaft, and high-speed gearing shaft and gas-compressor shaft. A rigid coupling connects starting motor and generator.

Regenerators. The two paralleled air-heating regenerators and the single gas-heating regenerator have all been designed for 75% effectiveness. Each has mild-steel tube plates welded into fabricated mild-steel shells. Bellows expansion joints in the shells accommodate differential expansion of tubes and shell.

Each main tube bank has 4146 mild-steel electrical-resistance-welded tubes expanded into the tube plates. Outside the main tube bank a group of thicker tubes acts as stay bars and is welded in position.

Baffling guides the air across the tube exteriors to make four cross-flow passes. Air enters at the top of the shells. Turbine exhaust flows from bottom to top of the tubes. The regenerators are about 20 ft high between tube sheets and weigh about 25 tons each.

The blast-furnace-gas regenerator is similar to the air regenerators but smaller. In addition it has inspection doors to give access to the tubes for cleaning.

Soot-blowing equipment stands at the bottom of each regenerator, takes air from the duct leading to the combustor. This limits cleaning to the time that the unit runs.

Controls. The integral gear type oil pump driven by the low-speed main gear also supplies the hydraulically operated controls. During starting a motor-driven auxiliary oil pump supplies pressurized oil.

A centrifugal spring-loaded main governor controls the speed of the unit when it runs alone, and the load when the unit is paralleled with others. A temperature controller overrides the governor when needed. Compressor air passed through a filter and reducing valves powers the temperature controller.

The unit can be started by a semi-automatic sequence control, with provision for out-of-sequence operation. The thermal-control panel houses all of the control system

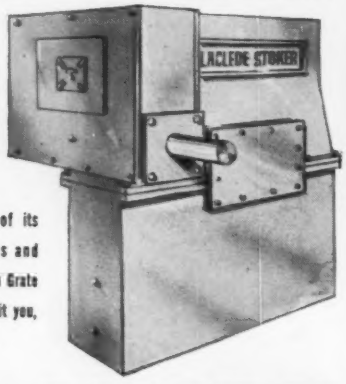
wherever your plant operating plans include water . . .

BETZ

CONSULTANTS ON INDUSTRIAL WATER PROBLEMS

BETZ LABORATORIES INC., Philadelphia 24, Pa.

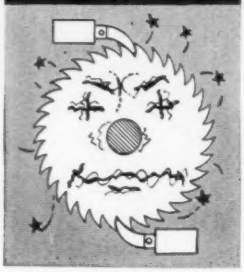
HERE'S THE FINEST...
LACLEDE'S
NEW MODERN
CHAIN GRATE STOKER
WORM GEAR DRIVE
YEARS AHEAD IN DESIGN...
AVAILABLE NOW!



To learn further of its many advantages and how Laclede Chain Grate Stokers can benefit you, write for details.

For smooth, uninterrupted motion, this continuous torque worm gear drive is far superior . . .

to any intermittent ratchet drive.



LACLEDE
STOKER COMPANY
4440 Hunt Ave. St. Louis 10, Mo.
FOUNDED IN 1904

POWER-FIELD BASICS . . .

HERE'S ONE you won't want to miss! It's a set of the informative and tremendously popular series on bringing engineering theory down to earth.

Bound in colorful plastic, this is priced (at $1.00*) to become a valuable addition to your engineering file.

*Deduct 10% on orders of 10 or more.

USE COUPON TO ORDER NOW

POWER Reader Service Dept, 26th Floor
330 West 42nd Street
New York 36, N. Y.

Please send me _____ copies of the new "Basics." I enclose $1.00* for each copy ordered.

Name (Please print or type) _____

Street Address _____

City _____

Zone _____ State _____

Gas turbine

Continued from page 178

while a separate cubicle houses the switchgear for the auxiliary motors. An ac source supplies most of the unit's auxiliary needs. A station battery supplies the dc needed to energize the alarm system and tripping devices.

After shutdown the sequence controller automatically starts the turning gear which runs intermittently. At the same time the auxiliary oil-pump motor goes on half speed to supply oil. If the ac supply fails, a dc-driven cooling-oil pump starts to supply cooling oil to the turbine bearings only. The unit shafts must then be turned by hand.

New units. Since the order for the Shelton gas turbine was obtained, two gas-turbine units for the Pakistan Industrial Development Corp have been ordered from Richardsons Westgarth; and through British Boveri, two units for the Kuwait Oil Co.

Free literature

Begins on page 161

11 **Insulating materials** are described in 20-p catalog. Thermal, mechanical, physical and chemical characteristics are given for spun-mineral wool insulating block, blankets, pipe coverings and cements. Specs, application instructions included. Baldwin-Hill Co, Industrial Insulation Div, 500 Breunig Ave, Trenton 2, N. J.

MATERIALS HANDLING

12 **Magnetic equipment** is subject of 48-p booklet. Includes info on automation units and vibratory units as well as separators. Eriez Mfg Co, 70D Magnet Drive, Erie, Pa.

13 **Sling chains** are described in 28-p catalog DH-105. Contains ordering info, safety factors, specs, table of wear. American Chain & Cable Co, Inc, American Chain Div, York, Pa.

CONTROLS, METERS AND INSTRUMENTS

14 **Miniature thermocouples** are covered in 28-p catalog. Describes and illustrates four basic designs: gasket, bayonet, protected and shielded models. Thermo Electric Co, Inc, Saddle Brook, N. J.

15 **Liquid and air,** steam or gas meters are topic of 6-p bulletin

NOT ONE FIELD CUT

in all This

MIDWEST

Shop-Fabricated Piping

...under a subcon...
and I would like to say the West Coast Division have on this job complied fully with the high standards of workmanship for which Midwest is known.

Throughout this entire project not once was a cut necessary to correct any piece of fabrication, and I might add in several instances close tolerances had to be met.

The above was not written on an impulse but as construction superintendent, this means but one thing: fast and low cost erection. Would appreciate your thanking Midwest personally for ...om a construction

Excerpt from letter by:
HOLMES & NARVER • Engineers-Constructors
828 South Figueroa St. • Los Angeles 17

Note particularly the words "*fast and low cost erection*" in the above letter. They characterize Midwest Shop-Fabricated Piping . . . whether for refinery, power plant or industrial installations. In this instance they were written by A. H. Chamberlain, construction superintendent, upon completing the installation of a Houdriformer Unit at the U.S. Oil & Refining Co., Tacoma, Washington.

There are three well-equipped Midwest pipe fabricating shops located to serve economically all sections of the country. Each is staffed by a highly skilled organization using the latest techniques. Each has wide experience on all kinds of projects so that the possibilities and limitations of all piping materials are well understood. You too will find it to your advantage to call in Midwest whenever you need fabricated piping.

MIDWEST PIPING SERVICE IS NATIONWIDE

MIDWEST PIPING COMPANY, INC.

Main Office: St. Louis 3, Missouri (P.O. Box 443)
Plants: St. Louis, Clifton, N.J. and Los Angeles

SALES OFFICES:
ASHEVILLE (BOX 446, SKYLAND, N.C.) • ATLANTA 9—72 11th ST., N.E.
BOSTON 27—426 FIRST ST. • CHICAGO 3—79 WEST MONROE ST.
CLEVELAND 14—616 ST. CLAIR AVE • HOUSTON 2—1213 CAPITOL AVE.
LOS ANGELES 33—520 ANDERSON ST. • MIAMI 34—2103 LE JEUNE RD.
NEW YORK 7—50 CHURCH ST. • PITTSBURGH 19, PA.—437 GRANT ST.
ST. LOUIS 4—1450 S. SECOND ST. • SAN FRANCISCO 11—420 MARKET ST.
TULSA—1640 E. 21ST ST.

SCHAUB DEAERATION
doesn't cost...it pays!

Removes feed water oxygen to a guaranteed .03 cc/liter

Assures a simpler system that costs less to own and operate

The Schaub .03 is, in fact, one of the simplest deaerators ever built, designed around a unique and more efficient operating principle that removes oxygen to an actual and GUARANTEED .03 cc/liter.

Fully vented operation at atmospheric pressure — combined with pinpoint temperature control and Schaub "live action" heating of storage water — provides a forceful breakaway of air molecules that assures more effective oxygen removal under widely varying load conditions. At the same time the special Schaub spray contact vent condensing principle practically nullifies steam losses.

The Schaub .03 is completely safe! It needs no premium cost pressure shell construction—requires neither adjustment nor attention during operation—and takes practically no maintenance whatever! Even the exclusive Chromasoid lining is guaranteed against shell corrosion failure for 10 years.

Finally, no pressure-vessel insurance premiums to pay — ever!

Whether you reckon in original cost or the operating savings you'll achieve, no other deaerator in the 3000 - 45,000 lb. range offers you so much protection for so little. For fuller information on the remarkable "hows" and "whys" and savings advantages of the Schaub .03 Deaerator method, send for Bulletin 1300.

FRED H. **SCHAUB** ENGINEERING COMPANY
2105 S. Marshall Boulevard, Chicago 23, Illinois

Please send me, without cost or obligation, my personal copy of your Bulletin 1300 on Boiler Feedwater Deaeration.

FRED H. SCHAUB ENGINEERING COMPANY
2105 South Marshall Blvd., Chicago 23, Illinois

Name.....

Company.....

Address.....

City.....Zone....State.....

Free literature

Begins on page 161

100-RI. Includes photos, drawings, cutaways and data tables. Builders-Providence, Inc, 345 Harris Ave, Providence 1, R. I.

16 **Data-gathering equipment** for field measurements of process variables is listed in 8-p bulletin E72-1. Illustrates units available as part of complete system or for use with existing measuring devices. Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio.

17 **Recording annunciator** is described in 4-p folder. Unit prints a tape record of time equipment is off normal. Panellit, Inc, Panalarm Div, 7401 N Hamin Ave, Skokie, Ill.

NUCLEAR ENERGY

18 **Disposal** of radioactive wastes is discussed in 10-p brochure. Emphasizes safety and cost considerations. Nuclear Science and Engineering Corp, Section 3-P, Box 10901, Pittsburgh 36, Pa.

19 **Research reports** available from the AEC are listed in a free price sheet. Contains 4000 titles. Office of Technical Services, U.S. Dept of Commerce, Washington 25, D.C.

PIPING, VALVES, FITTINGS

20 **Steam traps** for tracing and instrumentation service are discussed in 4-p catalog 200. Includes capacities, diagrams. Velan Steam Specialties Inc, 37 S River St, Plattsburg, N. Y.

21 **Planetary gear operator,** for use with wrench-operated h-p valves, is described in 4-p illustrated bulletin V-610. Contains selection, installation info. Rockwell Mfg Co, Meter & Valve Div, 400 N Lexington Ave, Pittsburgh 8, Pa.

22 **Quality control** for tubing is subject of 24-p booklet TB-420. Describes testing, inspection methods used by manufacturer in making steel tubing. Babcock & Wilcox Co, Tubular Products Div, Beaver Falls, Pa.

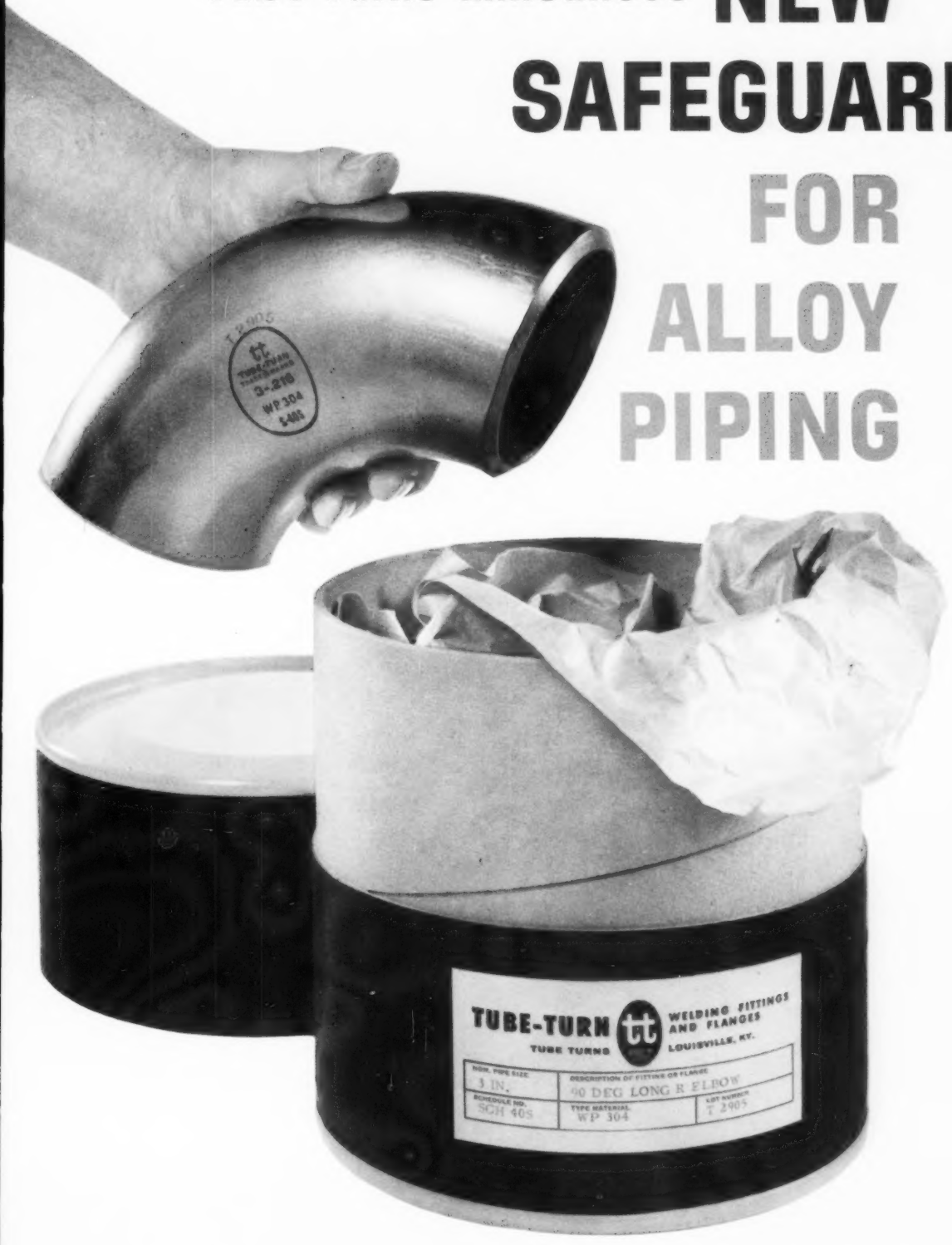
23 **Water-control valves** are described in 8-p bulletin G-5A. Includes installation photos for various models. Golden - Anderson Valve Specialty Co, 1241 Ridge Ave, Pittsburgh 33, Pa.

24 **Automatic shut-off valves** for overload protection of gages and instruments in hydraulic, pneumatic systems for pressure ranges from 10 to 10,000 psi are listed in 2-p spec sheet. Sprague Engineering Corp, 19300 S Vermont Ave, Gardena, Calif.

25 **Manual remote valve** controls are topic of 20-p design manual 5811.

(*Continued on page* 186)

Tube Turns announces **NEW SAFEGUARD FOR ALLOY PIPING**



For details, turn the page . . .

NOW ...individual packaging protects each TUBE-TURN® Alloy Welding Fitting and Flange

AVAILABLE IN...

STAINLESS STEELS	COPPER
ALUMINUM ALLOYS	SILICON BRONZE
NICKEL	RED BRASS
MONEL	ADMIRALTY METAL
INCONEL	TITANIUM
HASTELLOY B & C	ZIRCONIUM
	ZIRCALOY

...and other non-ferrous metals and alloys

MAIL FOR BULLETINS
on TUBE-TURN Alloy Fittings and Flanges

TUBE TURNS
224 E. Broadway, Louisville 1, Kentucky

Please send me bulletins on these fittings and flanges:

☐ Alloys ☐ Stainless Steel ☐ Aluminum

Company Name _____

Company Address _____

Your Name _____

Position _____

City _____ Zone ____ State _____

Your nearby Tube Turns' Distributor can supply your fitting needs in alloys and non-ferrous metals . . . as well as in carbon steel, wrought iron, carbon-moly and chrome-moly. This one source for all your requirements in welding fittings and flanges enables you to simplify purchasing and cut red tape.

Tube Turns is now safeguarding the top quality of its stainless steel, aluminum and other alloy products with individual packaging. All of these fittings in sizes through 12", and flanges through 8", are now wrapped in kraft paper and individually packaged in a rugged container, built to standards established by extensive testing. Hence, from point of rigid inspection to job site, *each* fitting is *protected* against damage.

Here is new *convenience*, too. Your fittings are easier to store. And each container is fully marked with description of fitting or flange, size, schedule, type material and production lot for positive, easy identification in the warehouse or on the job.

Here is another plus value you get when you specify TUBE-TURN* Alloy Fittings and Flanges, and buy them from your nearby Tube Turns' Distributor.

The trademarks "TUBE-TURN" and "tt" are applicable only to the quality products of Tube Turns.

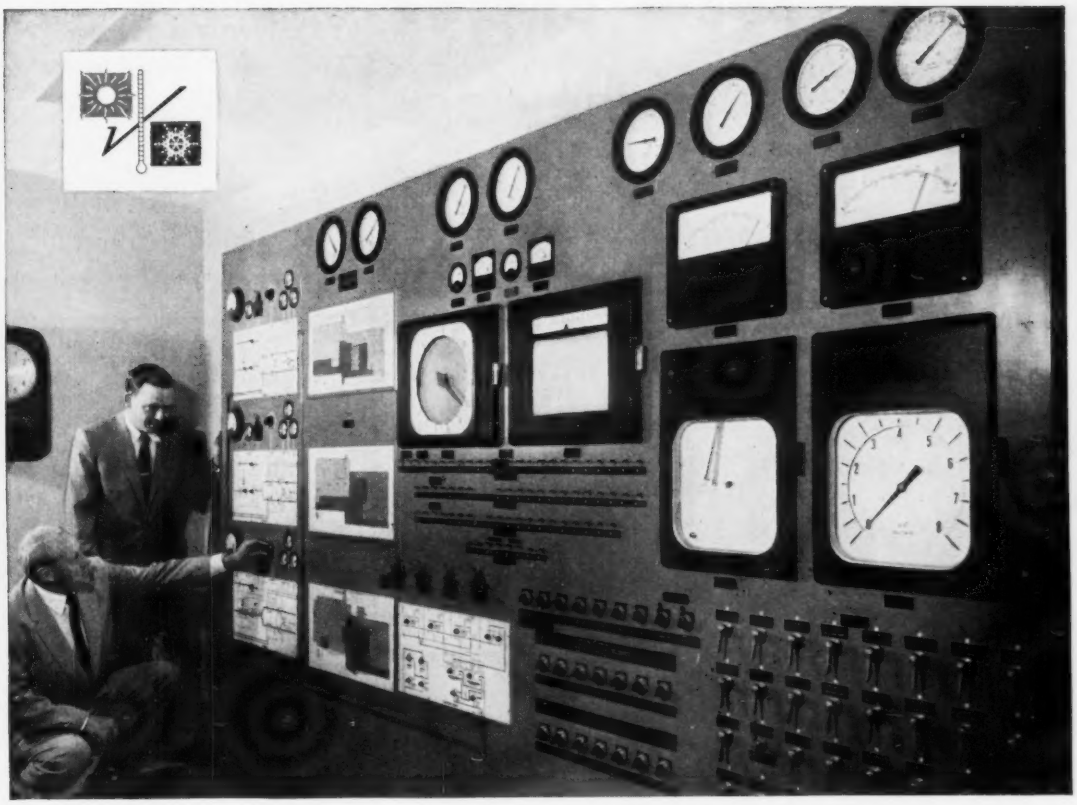
*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TUBE TURNS

DIVISION OF CHEMETRON CORPORATION
Louisville 1, Kentucky

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Detroit • Atlanta • New Orleans • Houston • Midland • Dallas • Tulsa • Kansas City • Denver • Los Angeles • San Francisco • Seattle
IN CANADA: Tube Turns of Canada Limited, Ridgetown, Ontario. DISTRICT OFFICES: Toronto, Ontario • Edmonton, Alberta • Montreal, Quebec • Vancouver, British Columbia

CHEMETRON



Centralized Control of Air Conditioning Saves Manpower, Assures Ideal Working Environment

North American Aviation, Inc., Los Angeles, California. Austin, Field & Fry, AIA, architects and engineers; Wm. Simpson Construction Co., general contractor; Western Air & Refrigeration Co., air conditioning contractor; all of Los Angeles.

Manpower savings of at least three men per day, reduced fuel and power consumption, longer equipment life and 24-hour-a-day comfort are made possible by this Johnson Control Center at North American Aviation's busy new headquarters!

From the Center, *one man* operates all the basic heating, cooling and air handling components of a modern high pressure, double duct air conditioning system.

To aid him, all vital operating data needed to keep the system functioning at peak efficiency are transmitted to the panel from remote locations throughout the windowless, three-story building. Simply by scanning the panel or pushing a button, the engineer can check fan operations, temperatures, pressures and related data from well over 100 key control points!

Johnson Control Centers are applied to buildings of all types and sizes. They assure the very best, most productive working environment your air conditioning can produce. And you'll quickly recover your investment through major savings in operating costs and manpower. For the facts, see your engineer, architect or local Johnson branch. Johnson Service Company, Milwaukee 1, Wisconsin. 105 Direct Branch Offices.

JOHNSON CONTROL

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

TEMPERATURE CONTROL SYSTEMS FOR SCHOOLS, OFFICES, FACTORIES, STORES, HOSPITALS, HOTELS, PUBLIC BUILDINGS

WARREN SCREW PUMPS
work 'round-the-clock
at Oklahoma Gas & Electric Company

Pumping heavy fuel oil

to the boilers at the RIVERBANK STATION of the Oklahoma Gas & Electric Company is a full-time job for these two Warren Screw Pumps (#5¼ Long Body)

For many months they have been providing 24-hour-a-day service at full efficiency for this important installation:

The heavy fuel is fired in a radiant type boiler with nominal steam capacity of 1,200,000 pounds per hour. The steam-driven turbo generator has a nominal capacity of 170,000 KW, and the turbine operates at 1800 PSIG and 1000°F. at the throttle valve, with reheat to 1000°F.

Operating temperature of the #6 Bunker "C" fuel oil is 100° to 225°F.; capacity is 225 GPM; discharge pressure is 675 PSIG; and using 150 HP—1150 RPM electric motors.

Warren Pumps are most important to the uninterrupted functioning of this installation. Like so many other power companies throughout the country, Oklahoma Gas & Electric Company is completely "sold" on Warren for long, dependable pumping service.

WRITE FOR BULLETIN 252

WARREN — CENTRIFUGAL — SCREW — RECIPROCATING — ROTEX

WARREN PUMPS, INC.

WARREN, MASSACHUSETTS

P-35

Free literature

Begins on page 161

Gives data, diagrams, drawings and photos for flexible-shaft and standard reach-rod controls. Stow Mfg Co, 443 State St, Binghamton, N. Y.

OTHER EQUIPMENT

26 **"Special hazard fire protection"** is title of 42-p book. Treats a highly technical subject for fire-protection engineers and the layman. Discusses water-spray, foam, carbon-dioxide, dry chemical, other types of extinguishers. Grinnell Co, Inc, Providence 1, R. I.

27 **Industrial air compressors'** features are listed in spec guide, catalog 37. Gives details of models in 25, 30, 40 and 50 hp, single and two stages. Dunham-Bush, Inc, Dept 37, West Hartford 10, Conn.

28 **Flexible gear couplings** are described in 20-p catalog C-5. Gives details, installation info, applications, lube data. Includes photos, diagrams. Sier-Bath Gear and Pump Co, Inc, 9275 Hudson Blvd, North Bergen, N. J.

29 **Fuel-oil** automatic conditioner is subject of 4-p bulletin. Unit pumps oil from main storage tank, circulates it at combustion temperature. Includes photos, specs, features. Power Mfg Co, Detroit Office, 6918 Greenfield Rd, Dearborn, Mich.

30 **Steam turbines,** 2000 to 16,500-kw units, are covered in 40-p bulletin 03B7654A. Gives cross sections of the four basic types for condensing, noncondensing, condensing automatic-extraction and noncondensing automatic-extraction operation. Includes complete data, 4-color diagrams. Allis-Chalmers Mfg Co, Milwaukee 1, Wis.

31 **Hydraulic cylinders** for 500 to 5000 psi service are subject of 32-p handbook. Includes info on various models, plus technical cylinder data on column strength, force, selection factors. Miller Fluid Power Div, 2040 N Hawthorne Ave, Melrose Pk, Ill.

32 **Hydrogen production** processes, types of plants, methods of purification, industrial applications are topic of 36-p booklet. Book includes diagrams, photos, charts and graphs. Chemetron Corp (formerly National Cylinder Gas Co), Girdler Construction Div, Box 174, Louisville 1, Ky.

33 **Rubber** fact book has 16 pages, helps in selection of O-rings and other ring seals. Sizes are cross indexed for comparison. Minnesota Rubber Co, 3630 Wooddale Ave, Minneapolis 16, Minn.

(*Continued on page 188*)

COMPLETE LINES OF WALWORTH VALVES for POWER PLANT SERVICE

Featuring Walworth Pressure-Seal Valves

Here are cast steel valves built for high-pressure, high-temperature service. The unique bonnet-to-body design utilizes internal line pressure for a tight, leakproof connection. The higher the pressure the tighter the bonnet joint! Bulky, heavy bonnet flanges, bonnet studs, and nuts are completely eliminated providing a modern valve design of truly streamlined proportions. Maintenance is simplified as Walworth Pressure-Seal Valves are easily assembled, disassembled, and insulated.

Walworth Pressure-Seal Valves are available in 600, 900, 1500 and 2500 Lb ratings, ASA B16.5 – 1957, and in a wide range of sizes and types. Complete information is available from your nearby Walworth Distributor – or – write Walworth for a free copy of Circular 16.

and including these valves for "*'round-the-plant*" use!

WALWORTH SMALL CAST STEEL Y-GLOBE VALVES. Simplified design eliminates many of the problems encountered in high-temperature, high-pressure service. No bonnet joint. Improved back-seat design means longer life for packing rings.

WALWORTH LUBRICATED PLUG VALUES. Easy turning—quick operating. Lubricant can be renewed while the valve is in service. Lubricant completely surrounds the plug ports for a tight seal against leaks. Remember, always use Walworth Lubricant in Walworth Lubricated Plug Valves.

WALWORTH BRONZE VALVES. Standardized lines of bronze valves provide an unsurpassed system of interchangeability of parts, drastically reducing inventory problems. Walseal Valves with brazing ends also available in a variety of types.

WALWORTH IRON BODY GATE VALVES. Straight-flow port design reduces fluid turbulence to a practical minimum. Seat rings of end-seated type are screwed into the body. Brass liner on glands assures greater resistance to corrosion and scoring. Available with threaded or flanged ends.

WALWORTH CAST STEEL GATE VALVES. Bolted bonnet, wedge gate, OS&Y. Bonnets and bodies are engineered to withstand pressure and minimize distortion. Heavy steel walls provide extra strength and longer life. Deep stuffing boxes in all sizes (2" to 24") insure tightness and maximum packing life. Also available in globe and angle types.

WALWORTH

750 THIRD AVENUE, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

WALWORTH SUBSIDIARIES: ALLOY STEEL PRODUCTS CO. • CONOFLOW CORPORATION • GROVE VALVE AND REGULATOR CO. M&H VALVE & FITTINGS CO. • SOUTHWEST FABRICATING & WELDING CO., INC. • WALWORTH COMPANY OF CANADA, LTD.

WHEN YOU SEE THESE GAUGES,
YOU WON'T BELIEVE THE LOW PRICES!

New line of standard industrial gauges has Grade A accuracy . . . premium gauge construction . . . at up to 40% below premium prices

Now, you can buy pressure gauges that are sturdier, more accurate, and have many of the top quality features of premium-priced process gauges . . . yet don't cost a nickel more than you've been paying for general purpose gauges. We guarantee that you can't find better values on the market than our new "A" Line.

Be sure to check the new "A" Line models against your specifications for any of a broad range of industrial applications—principally where steam, water, and oil pressures must be indicated.

Consider such remarkable design points as:

MEETS A.S.A. GRADE A STANDARDS — Guaranteed accurate within 1% of scale for the middle (working) half of scale and 1½% for remainder.

WIDE CHOICE OF OPTIONS—Aluminum cases standard, other materials available . . . panel or front-of-board mounting . . . variety of movements and Bourdon tubes . . . dial sizes, 3½ to 12 inches . . . for pressures to 10,000 psi or vacuum.

LONG LIFE AND EASY MAINTENANCE—You can select from a wide range of available components to meet your exact needs for rugged or corrosive service conditions, and be assured of maximum life with minimum maintenance. Entire gauge internals can be removed as a unit for inspection or calibration.

Find Your Nearest Distributor in the 'Yellow Pages'

You'll have to see the new "A" Line gauges to believe all the quality features and options offered at amazingly low costs. Ask your U. S. Gauge distributor for a demonstration today, or write for a copy of new Catalog 305.

UNITED STATES GAUGE
DIVISION OF AMERICAN MACHINE AND METALS, INC., SELLERSVILLE, PA.

USG

Free literature

Begins on page 161

34 **Circular slide rule** for simple calculations will be sent for the asking—instructions included. General Industrial Co, 5738 N Elston Ave, Chicago 30, Ill.

35 **Low-cost fasteners** are described in 6-p bulletin. Gives all technical data, specs. Rotor Clip Co, 114 Allen Blvd, Farmingdale, L. I., N. Y.

36 **Stainless steel** data chart gives corrosion-resistance info for 34 standard grades. Peter A Frasse & Co, Inc, 17 Grand St, New York 13, N. Y.

37 **Worm gear drive** for stokers is subject of new bulletin. Includes features, construction details. Laclede Stoker Co, 4438 Hunt Ave, St. Louis, Mo.

Marmaduke

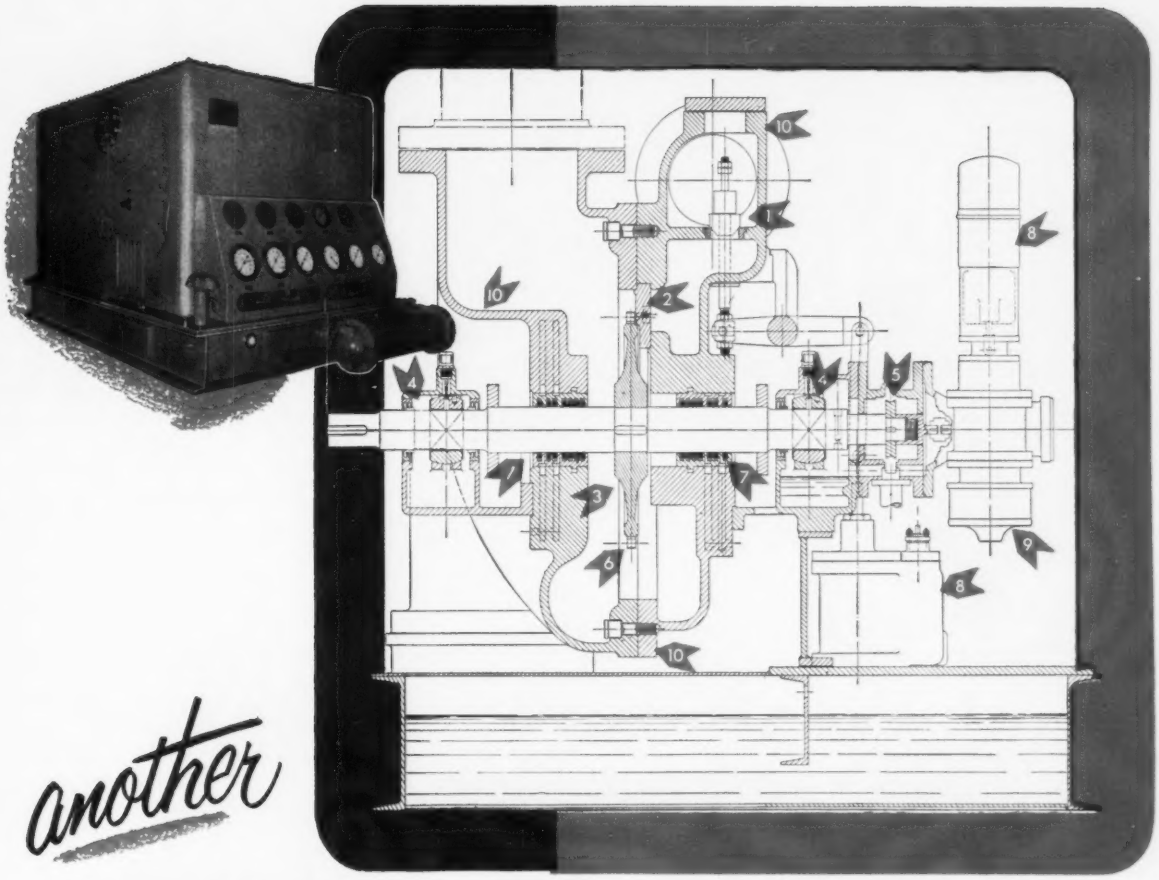
Continued from page 140

kw. In those days some manufacturers built 25% overload capacity into their turbines, generators and motors; today, you're lucky to get 10%. But we still had plenty of headaches.

"My problems began daily at peak-load time, which started coming on at 5:30 pm, then began dropping after 6:15 pm. Most of the load was from domestic electric cooking. In winter the peak load climbed to over 6000 kw. We handled that by asking the coal mines to stop cutting coal during that period. And they couldn't fool us because we could tell by the ammeter on each of the five circuits if a mine wasn't co-operating.

"Peak periods that winter were tough. The trick was to be prepared. Soon as my shift took over at 4 pm, I had my fireman clean the fires in the Kidwells and adjust the B&W grates for maximum firing. Then he'd fill all boilers to the top gage-glass nut with water. By 5:15 his safety valves were simmering and the old plant was all set, waiting for the big pull. Then I'd change over all the auxiliaries to steam drive to maintain the feedwater temperature. That also kept the draft fans running at top speed.

"One trick I always pulled at that time was to speed up both turbines to about 62 cycles. That created our maximum load and would get those



another

MURRAY INSIDE STORY . . . OR WHY MURRAY EXCELS FOR MULTI-VALVE COMPRESSOR DRIVE

1. Multiple automatic bar-lift inlet valves.
2. Stainless steel nozzle block.
3. Specially shaped forged alloy steel disc and shaft — separate or integral.
4. Spherical seated, pressure lubricated sleeve bearings.
5. Kingsbury thrust bearing.
6. Special integral spacer type accurately formed stainless steel blades.
7. Carbon or labyrinth type gland seals.
8. NEMA Class D precision oil relay governor with hydraulic servomotor.
9. Positive displacement, shaft driven lubrication oil pump.
10. Heavy duty, rugged construction throughout.

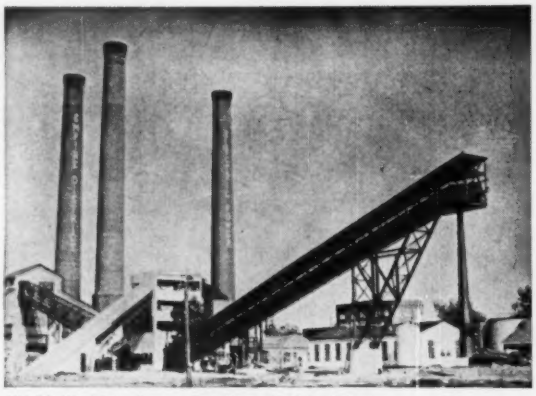
Our nearest representative will help you solve your turbine requirements. His name gladly sent on request.

Murray
TURBINES

MURRAY IRON WORKS COMPANY • BURLINGTON, IOWA

Builders of Steam Power Equipment for Nearly a Century

EARN EXTRA PROFITS IN SAVINGS



McNally Pittsburg developed this 250 ton per hour system for the EMPIRE DISTRICT POWER & LIGHT CO.

McNally Pittsburg assisted in developing this 300 ton per hour system for the KANSAS POWER & LIGHT CO.

—With Cost-Cutting

COAL-HANDLING SYSTEMS

Engineered for Your Plant

Are you paying "extra fare" luxury rates for that last ride your coal must take from the truck, car, or barge, to your bunkers?

Why pay more? Why risk breakdowns, when you can *save* extra "profits" and be sure of year-round efficiency.

McNALLY PITTSBURG Systems automatically handle more coal per dollar—minimum maintenance costs.

The men who know coal from the ground up will be glad to study your coal-handling problems with you. Mail coupon.

McNALLY PITTSBURG

"The Men Who Know Coal From The Ground-Up"

McNally Pittsburg Mfg. Corp., Dept. PO, Pittsburg, Kansas
Gentlemen: Send more information on your Coal-Handling Systems.

Name_____ Title_____

Company_____

City and State_____

Marmaduke

Continued from page 188

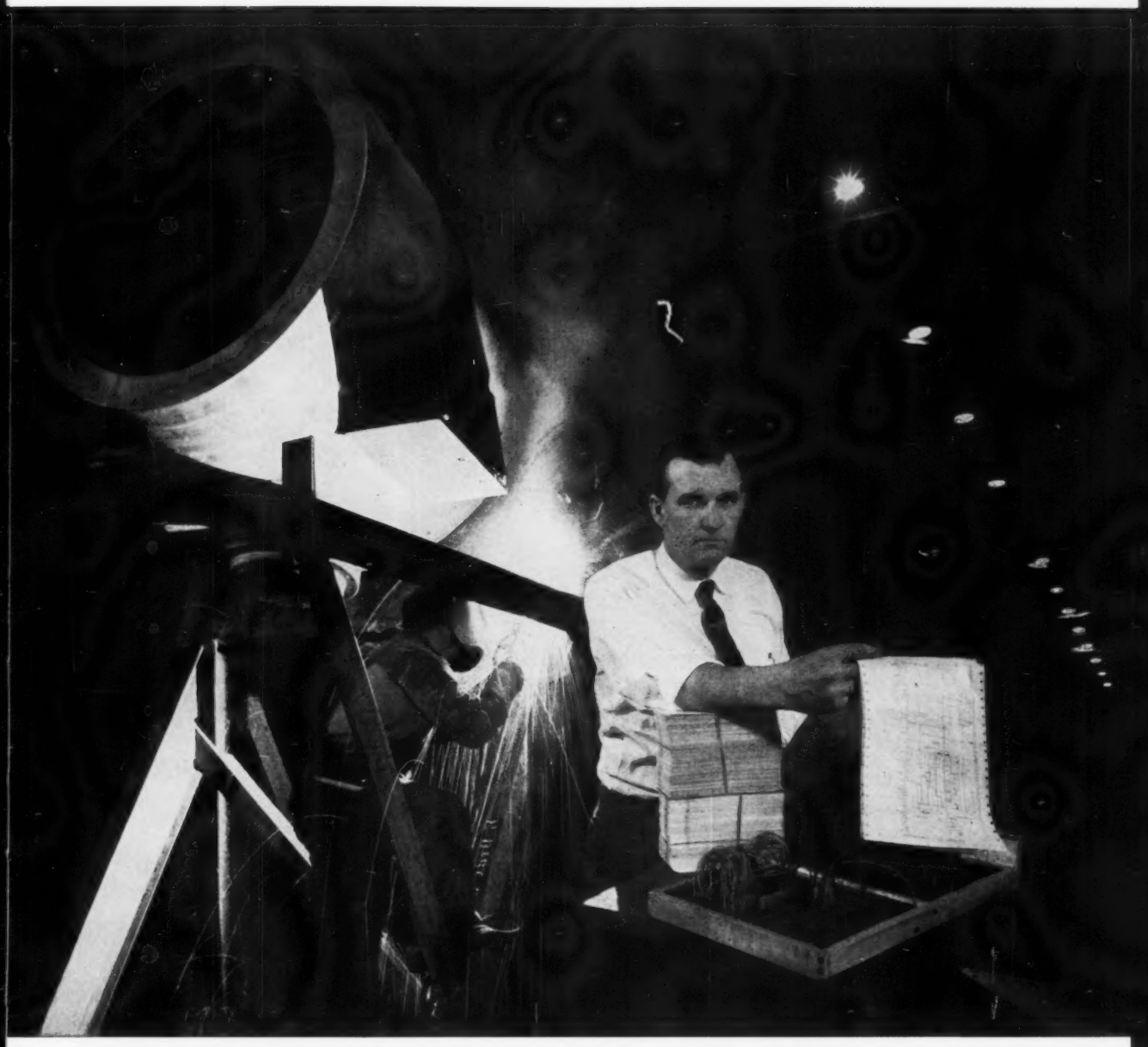
furnace arches really hot. Soon the load reached 5000 kw. Then the overload valves would start to open. By 5:45 the load was usually near 6000 kw and the speed would drop to a bare 60 cycles. But still the kilowatt meter crept up, causing those ancient generators to protest by groaning a deep, steady roar.

"One thing I watched closely during that time was the vacuum, because the extraction pumps were the weak link in that plant. They just couldn't remove all the condensate from the condensers at full load. So, soon as the condensate level reached the tube bundle, the vacuum would start dropping. When that happened the only thing I could do was open a bleed valve to let that excess condensate discharge to the sewer in the basement. And during that time, while one steam-driven feed pump ran all out, the water level would drop slowly in all boilers. I didn't put on an extra feed pump because that would have dragged the steam pressure down.

"By the time 6:10 rolled around things were critical as hell. Turbine speed was down to 58 cycles, steam pressure was barely holding, and the water was down to a quarter glass or even lower. If the load didn't start dropping off by the time that water reached the bottom nut, I'd have to open one of the coal-mine circuits. But first I'd lower the system voltage nearly 10%. That helped a great deal, for the overload was mostly resistive.

"At that point there were usually only minutes left to decide whether I'd have to cut somebody off. First line I'd open would be a mine load that hadn't stopped cutting coal as requested. By opening their breaker for 10 seconds, then closing it, I'd stop the mine ventilation fans. It would be several minutes before someone could restart them. And by that time the peak load would start dropping. "I learned that by juggling the extraction-pump bleeds, manipulating the system voltage, and by making quick decisions about cutting someone off, I could squeeze by.

"The plant would groan on in that way until 6:15, then slowly the load would let up. First the water level would begin to climb, then the volt-



Automatic data processing, applied to the many variables of thermal design, results in higher efficiency of ALCO *feedwater heaters.*

HOW DO YOU FIGURE A FEEDWATER HEATER?

The trend to higher pressure and temperature in utility and industrial power plants demands *exact* design of feedwater heaters for the best heat-rate economy. ALCO, a 30-year pioneer in the heat transfer field, is again pacing the industry by focusing thermal engineering on solutions to this problem.

Advanced data on heat transfer and fluid flow from ALCO's new thermal laboratory, programmed through new electronic digital and analog computers, permits ALCO to offer the most accurate feedwater-heater thermal designs available today. Already in service and on order for the country's most efficient steam-generating plants, these heaters are proving their economy and reliability.

For more information, contact your nearest ALCO sales office or write for brochure on feedwater heaters to: ALCO Products, Inc., Dept. 132, Schenectady, New York.

ALCO

ALCO PRODUCTS, INC.

NEW YORK

SALES OFFICES IN PRINCIPAL CITIES

Locomotives · Diesel Engines · Nuclear Reactors · Heat Exchangers · Springs · Steel Pipe · Forgings · Weldments · Oil Field Equipment

Before you buy any boiler
compare quoted prices with REAL COSTS

New Cleaver-Brooks cost analyzer clears "quotation" confusion — reveals ALL costs

Get *all* the costs . . . the *real* costs . . . down on paper before you recommend or specify a boiler to your clients. On many boiler installations "quoted prices" seldom agree with the total costs, as you may have learned. This is frequently the case with so-called "built-up" boilers assembled on the site.

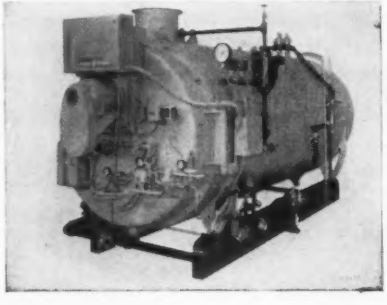
Cleaver-Brooks' cost analysis enables you to compare all material costs (boiler, steam trim, burner, refractory, controls and other equipment) and installation labor costs. You'll know the "real costs" on the complete installation before you start.

Real eye-opener

The figures you'll see may be startling. In most cases the cost analysis proves a Cleaver-Brooks costs *less*. On-job time is drastically reduced because Cleaver-Brooks packaged units are fully assembled, ready to install. Cleaver-Brooks boilers give you more in performance, too . . . each boiler is fully fire-tested at the factory under load, tuned to peak economy. Starting service and on-the-job operator training by authorized field engineers further decreases your over-all costs.

Contact your Cleaver-Brooks agent

Once you add up all the benefits of a Cleaver-Brooks "one-cost" package . . . the proved trouble-free economy of exclusive four-pass, forced-draft design, you'll find it pays over and over to analyze costs carefully before you buy. See your Cleaver-Brooks agent for details or write Cleaver-Brooks Company, 301 E. Keefe Ave., Milwaukee 12, Wisconsin, Dept. J.



Choose from 19 sizes, 130 models, 15 to 600 hp. Oil, gas and combination oil/gas fired — steam or hot water for heating or processing.

Cleaver Brooks
ORIGINATORS OF SELF-CONTAINED BOILERS

Marmaduke

Continued from page 190

age would be restored and the bleeds shut down. Gradually the frequency would climb to 62 cycles again. So by 8 or 9 pm the electric clock would come ahead to the correct time.

"You pushbutton station operators can't give that kind of service today," roared Marmy, giving all of us a menacing look. "If your speed drops everyone's clock runs slow. And they remain slow because you haven't the guts to speed up above 60 cycles.

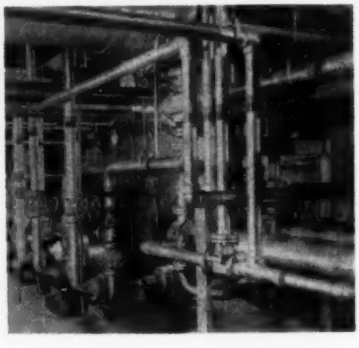
"Hell," blasted Marmy, pounding his huge fists on the bar, "You modern operators just haven't had the thrill of tickling the ribs of an old steam power plant to get every last drop of juice out of her."

With that, the cantankerous old consultant turned to his bottle. The cash customers got back to their drinking and yakking. I shoved off for my office to get Marmy's words of wisdom into print for this issue.

—Steve Elonka

Reports from the field

Begins on page 142

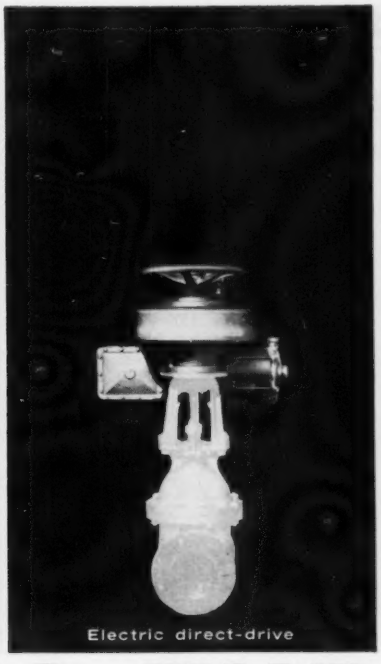


Bacteria, engines and pipes work in happy cooperation

About 300 tons of piping are used in an Akron, Ohio sewage-disposal plant. The pipes take water from heat exchangers on four 700-hp combination diesel-oil and sewage-gas engines, transport it 1000-ft underground to a sludge-digestion building. The piped water leaves the engine jackets at 220 F and keeps the sludge, pumped from six 95-ft diameter digestion tanks, at 90-95 F.

(*Continued on page* 196)

Electro-hydraulic



Electric direct-drive

Air-actuated

WHAT'S THE BEST VALVE OPERATOR FOR YOUR PARTICULAR JOB?

Obviously, there is no single operator which is "best" for every job. That's why General Controls offers all three, leaving the choice up to you.

Take the famous General Controls **HYDRAMOTOR**, for example. You'll find this powerful electro-hydraulic operator ideal for line sizes up to 8" for high-pressure, high-flow applications. Two-wire, slow-opening, fail-safe.

For the really big jobs, line sizes up to 60", it's the General Controls **TORK-MASTER**. This gear-driven electric operator can be adapted to new or old systems--*and with a minimum of costly down-time during the changeover.*

For heavy duty proportioning applications, you'll find the **HAMMEL-DAHL** air-operated diaphragm valve worth looking into. *And no electrical control or power circuits are required in proportioning operations.*

No matter which you select for your particular job, the important thing to remember is: *General Controls is a single source for all three types... and in all standard sizes.* For full information, expert field help, write today to

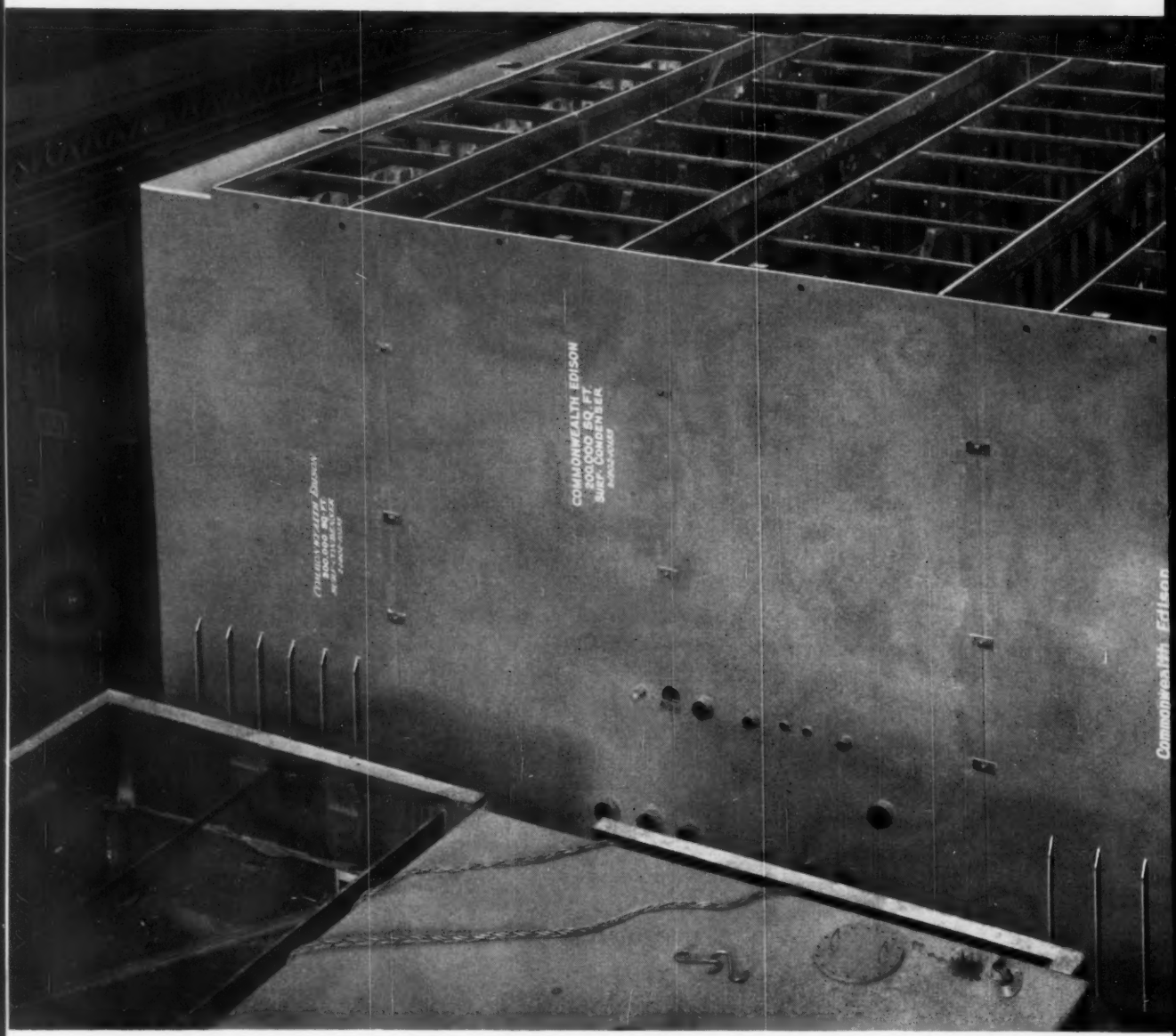
GENERAL CONTROLS

America's Finest Controls for Home, Industry, and the Military

Glendale, California • Skokie, Illinois • Guelph, Ontario, Canada

Six Plants—13 factory branch offices serving the United States and Canada

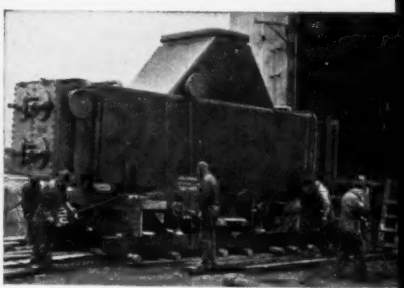
Another Example of Allis-Chalmers



Other Allis-Chalmers Firsts

First condenser with welded tubes to insure against condensate contamination. Welded construction forms a seal with tube sheets to meet new problems created by supercritical pressure, nuclear power, and once-through boiler installations.

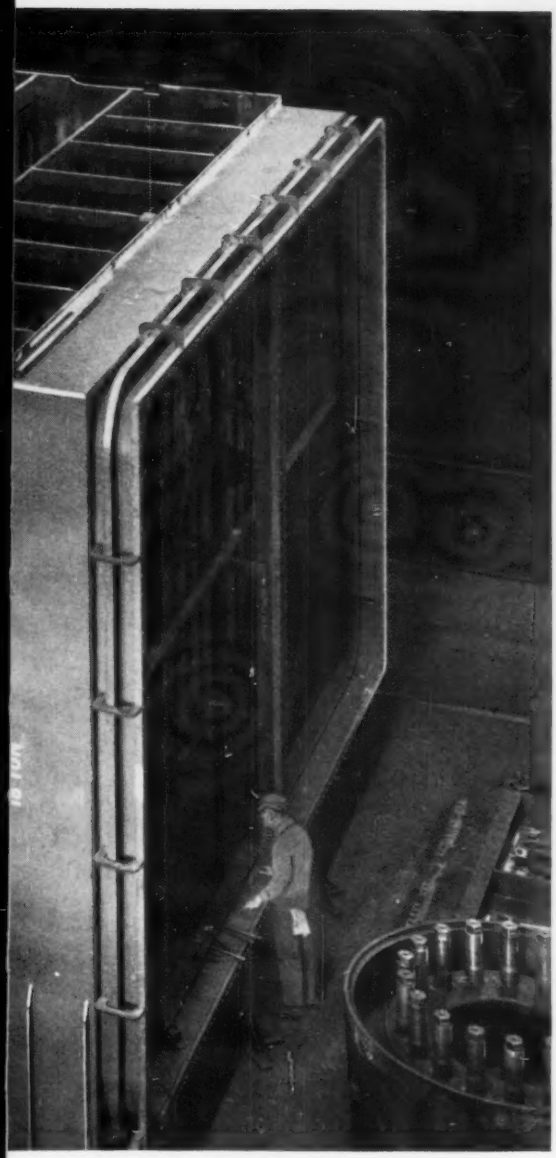
First condenser for first commercial-type nuclear power plant in operation is Allis-Chalmers 5300-sq-ft unit with aluminum tubes, double tube sheets, special leak tightness.



A-C ALLIS-CHALMERS

A-5693

Condenser Leadership



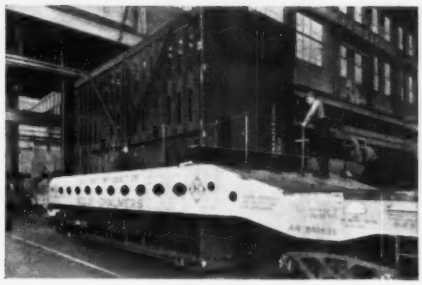
World's Largest Condenser

200,000-square-foot single-shell condenser for Commonwealth Edison

Engineering ability to handle the extraordinary jobs, such as this giant unit, accounts for Allis-Chalmers continued leadership in condenser development. The unit will serve another A-C achievement—a 327 mw steam turbine generator at the utility's Fisk Station.

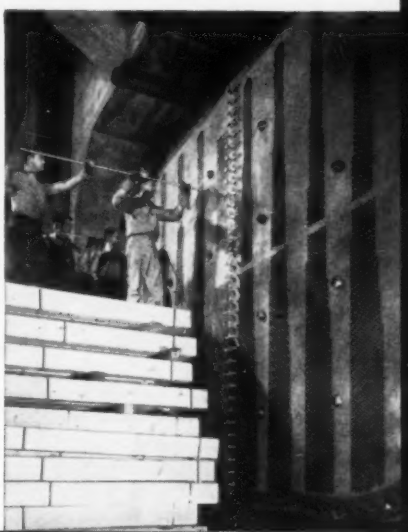
Installation of so large a condenser is not a simple task. However, a unique method devised by A-C is used to minimize erection problems. Complete factory assembly aligns the sections perfectly. Dowel and pull-up blocks are installed at each joint to insure exact alignment when condenser is reassembled in the field. Specially built freight cars permit shipment of the entire shell in only four sections.

For more information on the most advanced developments in condenser engineering, call your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.



First with specially built freight cars to accommodate large condenser sections, thereby reducing shipping problems, cutting installation time and costs.

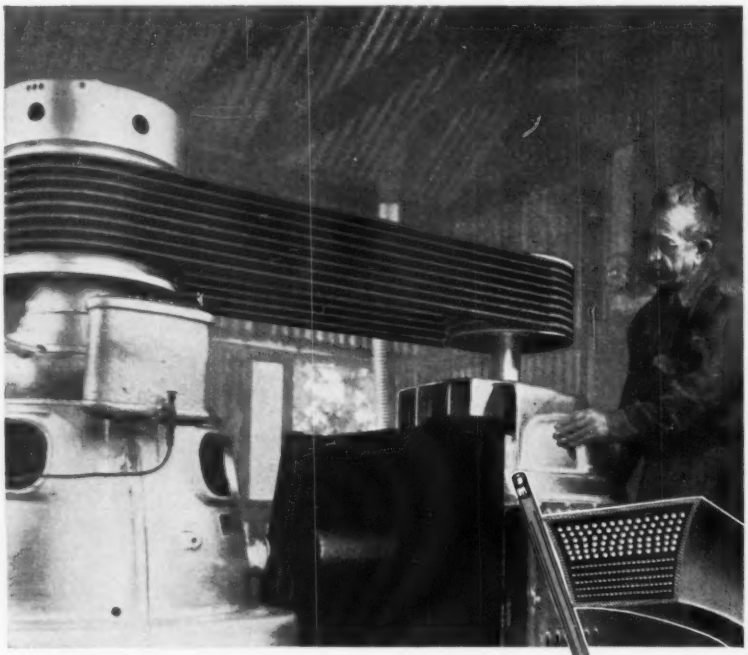
First full-size condenser in public utility to incorporate aluminum tubes. This installation is part of a long-range study that may lead to industry-wide savings.



ALLIS-CHALMERS

A-5693

No. 1 choice of industry...



the V-belt with concave sides

It is easy to see why concave sides insure far longer belt life... and make Gates the industry's first choice in V-belts.

Just make this simple test: Bend a Gates V-Belt with concave sides (Fig. 1) as if it were going around a sheave. Feel how the sides fill out... become perfectly straight (Fig. 1-A).

Note how this belt makes full contact with the sides of a sheave... grips the sheave evenly, distributing wear uniformly across the sides of the belt. Uniform wear lengthens belt life — keeps costs down.

With a straight-sided belt the sides bulge out on the bend and wear is concentrated on the bulge. Uneven wear shortens belt life — increases belt costs.

Because Gates V-Belts with concave sides are so universally preferred, they are also the **most widely available.** There are Gates distributor stocks in industrial centers throughout the world.

The Gates Rubber Company, Denver, Colorado

Gates *World's Largest Maker of V-Belts* TPA 313

Gates VULCO ROPE Drives

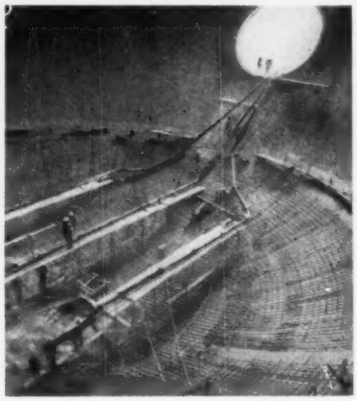
Reports from the field

Begins on page 142

This temperature keeps bacteria working on the sludge at optimum speed, so that a third of sludge's solid weight is changed to 70%-methane 30%-carbon dioxide gas. The gas is collected in a 53-ft sphere for use as fuel in the engines.

System eliminates the need for fuel-oil heating of sludge. The Jones & Laughlin piped water is also used for heating blower and gallery buildings in the plant.

The Botzum plant serves 75 sq mi and 350,000 people. Total plant capacity is 62.5 million gal per day average flow, 125 million gal maximum flow.



They've begun pouring— 22,000 cu yd of concrete

Concrete is being pumped into the 190-ft steel sphere of the Dresden Nuclear Power Station, in pipes coming through a hole cut in the sphere's side. Foundations and shielding for the reactor assembly should take 22,000 cu yd of concrete. The reactor will produce steam to operate the 180,000-kw plant, expected to be nation's first full-scale privately financed power plant.

Calendar of Events

Aug 18-21—American Society of Mechanical Engineers and **American Institute of Chemical Engineers,** Heat-Transfer Conference. Northwestern University, Evanston, Ill. Details from ASME, 29 W 39th St, New York 18, N. Y.

Aug 20-22—American Society of Civil Engineers, Hydraulics Confer-

Here's a vertical turbine with

TERRY SOLID WHEEL

and all its advantages

When it comes to judging a turbine's ability to deliver in vertical service, ratings tell only half the story. It's the Terry construction refinements that give you assurance of long-range operational economy: Thrust bearing designed to absorb external pump thrusts ... carbon ring glands specially made for vertical operation ... casings and bearing housings split vertically for easy accessibility.

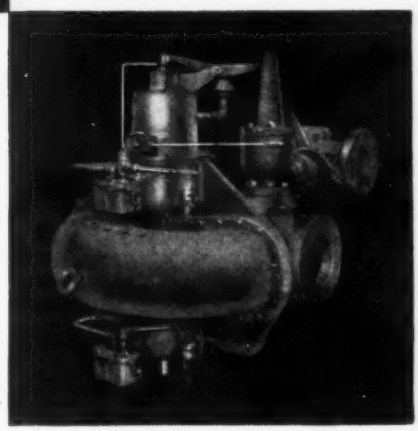
But most important, the Terry vertical turbine has an *almost* indestructible rotor. A single forging of special composition steel, it has no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

If your application demands a vertical turbine, specify Terry solid wheel. Available in capacities from 5 to 300 horsepower. And remember, the extra durability built into these vertical turbines is typical of every turbine in the complete Terry line.

For further information, send for a copy of bulletin S-137.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

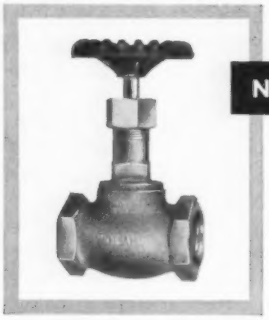


TT-1210

3
NEW

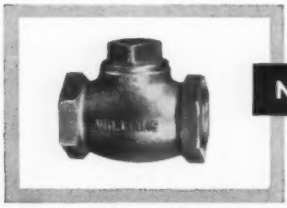
D.T. **Williams** valves
add another plus to a
broad line of Quality Valves

Quality is the watchword that governs the design and the manufacture of every D. T. Williams valve. From castings to final assembly, careful machining, thorough inspection, and rigid tests combine to produce valves that will perform to the highest standards. This is the reputation and the record of D. T. Williams over the years. It is the reason you can buy with confidence when you specify D. T. Williams Valves.
These valves meet Government, Marine and Industrial specifications.



No. 50 Bronze Globe Valve—Bronze Disc. This valve has an integral seat, deep stuffing box, molded ring packing and screw ends. Swivel disc is provided on ¾″ and larger sizes. Steam pressures to 125 lbs. and non-shock water, oil or gas to 200 lbs., at 150° F. Available in sizes ⅛″ to 3″.
Meets Government Specification WW-V-51, Class A, Type I.

No. 55 Bronze Angle Valve—Bronze Disc. Has an integral seat, deep stuffing box, molded ring packing and screw ends. Swivel disc is provided on ¾″ and larger sizes. Steam pressures to 125 lbs. and non-shock water, oil or gas to 200 lbs., at 150° F. Sizes ⅛″ to 3″.
Meets Government Specification WW-V-51, Class A, Type II.



No. 60 Bronze Horizontal Lift Check Valve—Bronze Disc. Provides integral seat and screw ends. For steam pressures to 125 lbs. and non-shock water, oil or gas pressures to 200 lbs., at 150° F. Available in sizes ⅛″ to 3″.
Meets Government Specification WW-V-51, Class A, Type III.

Always specify D. T. Williams Valves . . .
the valves with a reputation built on quality and performance.

Detroit Controls Division of American-Standard, 5900 Trumbull Ave., Detroit 8, Mich.

AMERICAN-Standard
DETROIT CONTROLS DIVISION

Reports from the field

Begins on page 142

ence. Baltimore Hotel, Atlanta, Ga. Details: ASCE, 33 W 39th St, New York 18, N. Y.

Sept 3-5—American Institute of Electrical Engineers and **National Electrical Manufacturers Assn,** First National Conference on Electrical-Insulation Application. Cleveland, Ohio. Details from T F Hart, Union Carbide Corp, Silicones Div, 30 E 42nd St, New York 17, N. Y.

Sept 4-5 — American Society of Mechanical Engineers, International Conference on Air Pollution. Statler Hotel, New York. Details from ASME, 29 W 39th St, New York 18, N. Y.

Sept 7-11—World Power Conference. Queen Elizabeth Hotel, Montreal. Details from Editorial Asso Ltd, Suite 220, 1255 University St, Montreal, Quebec, Canada.

Sept 15-17—American Institute of Electrical Engineers, Power-Industry Computer-Application Conference. King Edward Hotel, Toronto. Details: J R Leslie, Ontario Hydro, 620 University Ave, Toronto 2, Ontario, Canada.

Sept 15-17—American Society of Mechanical Engineers, Process-Industries Conference. Statler Hotel, Buffalo, N. Y. Details from ASME, 29 W 39th St, New York 18, N. Y.

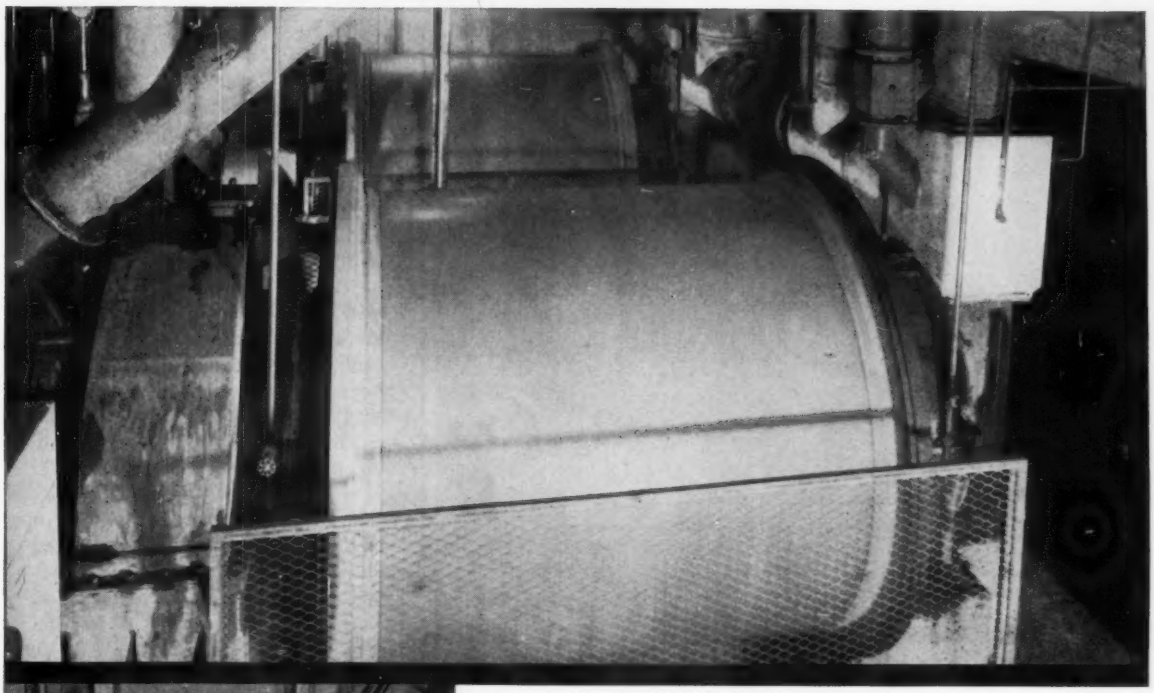
Sept 15-19—Instrument Society of America, 13th Annual Instrument-Automation Conference and Exhibit. Philadelphia Convention Hall, Philadelphia, Pa. Details from F J Tabery, 3443 S Hill St, Los Angeles 7, Calif.

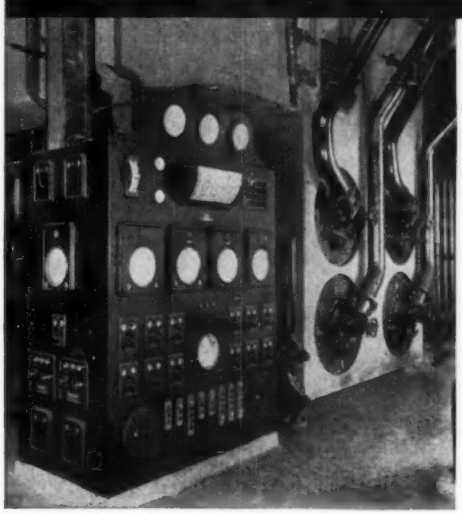
Sept 22-24 — Standards Engineers Society, 7th Annual Meeting. Benjamin Franklin Hotel, Philadelphia, Pa. Details from SES, Box 281, Camden 1, N. J.

Sept 28-Oct 1—American Society of Mechanical Engineers, Power Conference. Statler Hotel, Boston, Mass. Details: ASME, 29 W 39th St, New York 18, N. Y.

Sept 29-Oct 3—American Society

KENNEDY Pulverized Coal Firing System





. . . For Economy!

Shelby, Ohio—Municipal Light Department selects KENNEDY Pulverized Coal Firing System for 90,000 lb./hour steam plant generating 475 psig steam.

Shelby chose pulverized coal because of the availability of low cost coal, improved combustion efficiencies and lower stack losses, and because of its instant response to demand changes.

Shelby chose KENNEDY because no other pulverized coal firing system includes these desirable features:

- Fully air swept
- Coal pulverized to superfineness
- Coal completely carbureted, ready for combustion
- Big trunnions for air sweeping
- Balls added without shutting down
- Low operating and maintenance costs
- 85 to 90% through 200 mesh
- 20% moisture removed while pulverizing
- Pulverizes any coal—bituminous, anthracite or coke
- Tramp iron aids in pulverizing
- Reserves of fuel for fast response to demand

Consult KENNEDY before you specify your next firing system.

KENNEDY VAN SAUN
MANUFACTURING & ENGINEERING CORPORATION
405 PARK AVENUE, NEW YORK 22, N. Y. • FACTORY: DANVILLE, PA.

NEW BULLETIN

IMPROVED MODELS

COMPLETE LINE

NEW TYPES

Instantaneous speeds—variations in speeds—average measuring in RPM or FPM—the newest model instruments are described in this new Biddle Bulletin. Handy Selection Chart gives name, range, description and accuracy of all the tachometers in the Biddle line—resonant reed—centrifugal—chronometric—hand and fixed types. Request your copy today.

THERE'S A BIDDLE HAND TACHOMETER TO SUIT YOUR NEEDS

NAME	TYPE	RANGE	DESCRIPTION
JAGABI Speed Indicators	Chronometric	up to 100,000 rpm	Integrating—Measures average speeds
JAGABI Tachoscope	Chronometric	up to 20,000 rpm	A stopwatch and revolution counter in one—Time and motion integrated mechanically
JAGABI Five-Range Hand Tachometer	Centrifugal	up to 48,000 rpm	5 individual ranges—Direct-indicating—Shows instantaneous speeds and speed variations
JAGABI Triple-Range Hand Tachometer	Centrifugal	up to 40,000 rpm	3 individual ranges—13-inch scale—Twice around dial—wide range in each range
JAGABI Single-Range Tachometer	Centrifugal	300 to 4,000 rpm	Exceptionally wide range—Double length 13-inch scale
JAGABI Single-Range Precision Hand Tachometer	Centrifugal	1,000 to 6,000 rpm	Dial diameter 120mm (4.7 in.) open, easy-to-read scale
JAGABI Tachograph	Centrifugal	up to 12,000 rpm	A recording tachometer—Provides permanent chart records
DR. HORN Hand Tachometer	Centrifugal	up to 30,000 rpm	6 ranges—Simple, sturdy construction—Overspeed protection
JONES Single-Range Hand Tachometer	Centrifugal	up to 10,000 rpm	Open equi-spaced scale—with stop button
JONES Double-Range Hand Tachometer	Centrifugal	up to 5,000 rpm	Open equi-spaced scale—with stop button
JONES Triple-Range Hand Tachometer	Centrifugal	up to 50,000 rpm	Open equi-spaced scale—with stop button
JONES Stationary Tachometers	Continuous indicating fixed type	up to 10,000 rpm	3", 4" and 6" diameter-dials—Uniform scale divisions—Heavy duty
Accessories for Jagabi, Dr. Horn, Jones			
METRON 3 in 1 Hand Tachometer	Electric (Battery)	up to 100,000 rpm (with adapters)	3 single ranges—only 1 visible at a time
FRAHM Hand Tachometers	Resonant Reed	900 to 100,000 rpm	Easy to use—Safe—No contact with moving parts—No wearing parts—No oiling—No maintenance—Not injured by overspeeding—Imposes no load on small motors or machines under test
SWEENEY Tachometer Tester	Built on the synchronous motor principle		Tests all but the resonant reed type tachometers—Accurate as an electric clock

WRITE FOR BULLETIN 35-P B-808

JAMES G. BIDDLE CO.

Electrical Testing Instruments • Speed Measuring Instruments

Laboratory & Scientific Equipment

1316 ARCH STREET, PHILADELPHIA 7, PA.

Reports from the field

Begins on page 142

of Tool Engineers, Semi-Annual Meeting and Western Tool Show. Shrine Exposition Hall, Los Angeles, Calif. Details: ASTE, 10700 Puritan Ave, Detroit 38, Mich.

Oct 9-10—American Society of Mechanical Engineers and **American Institute of Mining and Metallurgical Engineers,** Fuels Conference. Old Point Comfort Hotel, Old Point Comfort, Va. Details from ASME, 29 W 39th St, New York 18, N. Y.

Oct 13-15—American Society of Mechanical Engineers and **American Society of Lubrication Engineers,** Lubrication Conference. Statler Hotel, Los Angeles, Calif. Details from R B Purdy, Socony Mobil Oil Co, 150 E 42nd St, New York, N. Y.

Oct 13-17—American Society of Civil Engineers, Civil Engineering Show, in conjunction with the Annual Convention. Hotel Statler, New York. Details: ASCE, 33 W 39th St, New York 18, N. Y.

Oct 15-17 — Natural Resources Council of Denver Chamber of Commerce, Second Energy Resources Conference. Brown Palace Hotel, Denver. Details from Denver Chamber of Commerce, 1301 Welton St, Denver 4, Colo.

Oct 27-31—American Society for Metals, National Metal Exposition and Congress. Cleveland Public Auditorium. Details from ASM, 7301 Euclid Ave, Cleveland 3, Ohio.

Oct 29-30 — Armour Research Foundation, Computer Applications Symposium. Morrison Hotel, Chicago. Details from Armour Research Foundation, Chicago, Ill.

John Yellott Associates is new consulting firm

New mechanical-engineering consultant firm will specialize in steam- and gas-turbine power generation, fuel selection and utilization, dust collection and the application of solar energy to space heating and cooling. Offices of the new consulting firm are at 901 W El Caminito,

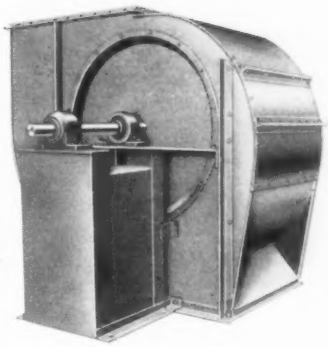
CLARAGE FANS FOR YOUR INDUSTRIAL AIR TRAVEL

Blowers and exhausters for diversified industrial applications.

Standard models promptly available.

Clarage builds air handling and conditioning equipment exclusively — concentrated know-how!

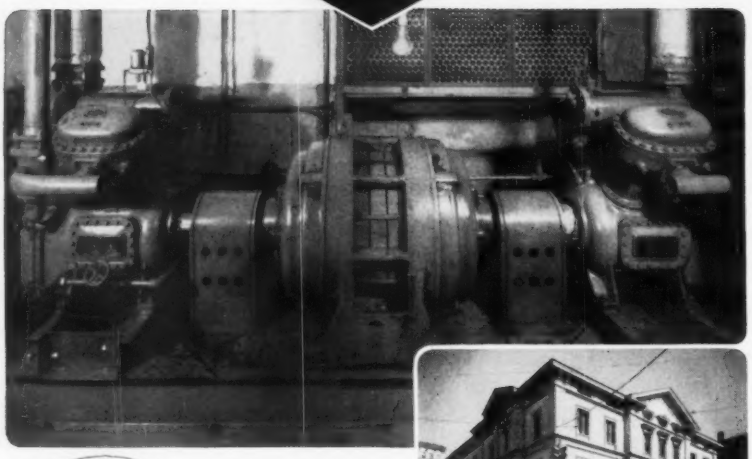
When you want equipment designed and built for "the long pull"— to stretch your equipment dollar to the utmost — call on CLARAGE FAN COMPANY, Kalamazoo, Mich.



CLARAGE ... *dependable equipment for making air your servant*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

17 YEARS



TVA OFFICES AT KNOXVILLE, TENN.

FRICK "ECLIPSE" COMPRESSORS

AIR CONDITION TVA OFFICES

TENNESSEE VALLEY AUTHORITY
KNOXVILLE, TENNESSEE

Frick Company
Waynesboro
Pennsylvania

Gentlemen:

We have a Frick central air-conditioning system in our Old Post Office Building which was installed by your engineers in 1940. It consists of four compressors and two evaporative condensers.

As this equipment has been in continuous use throughout each year for seventeen years, we feel that it is time for a thorough check, and repairing or replacing of necessary parts.

To get a complete and competent check, and proper recommendations, we would like to have one of your staff engineers or field representatives examine our equipment and advise on necessary corrections; also to furnish any cost estimates.

If any of your factory personnel is planning on being in this area in the near future, we would appreciate their stopping here and making the inspection. In the event they do, would you advise us as to the date.

Very truly yours,
A. L. Boyd
Eastern District Manager
Office Service Branch

Frick equipment is world renowned for being better-built, more economical, and giving a lifetime of dependable service.

What are your COOLING needs? If you want cool air, cold water, ice, extremely low temperatures, or refrigeration for quick freezing and processing—in any commercial or industrial sizes—call in a Frick representative at the planning stage for recommendations and estimates. They have the specialized knowledge and equipment to solve your cooling problems.

DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA., U.S.A.

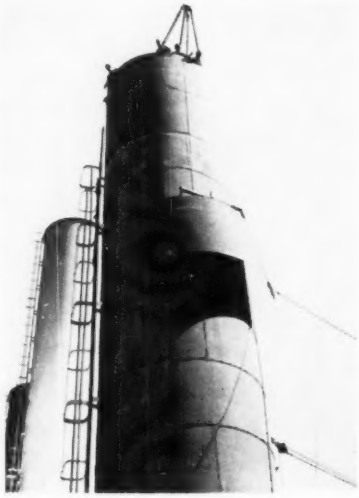
Reports from the field

Begins on page 142

Phoenix, Ariz. The firm is headed by John I Yellott, a registered professional engineer in Arizona, Maryland, New Jersey.

Yellott has served as atomic-power-generation consultant for the U. of Chicago. He directed research in the coal-burning gas-turbine program of Bituminous Coal Research Inc. Most recently, he's held down the posts of assistant director of Stanford Research Institute and executive director of the Assn for Applied Solar Energy.

His societies include ASME, NSPE, American Society of Heating and Air Conditioning Engineers.



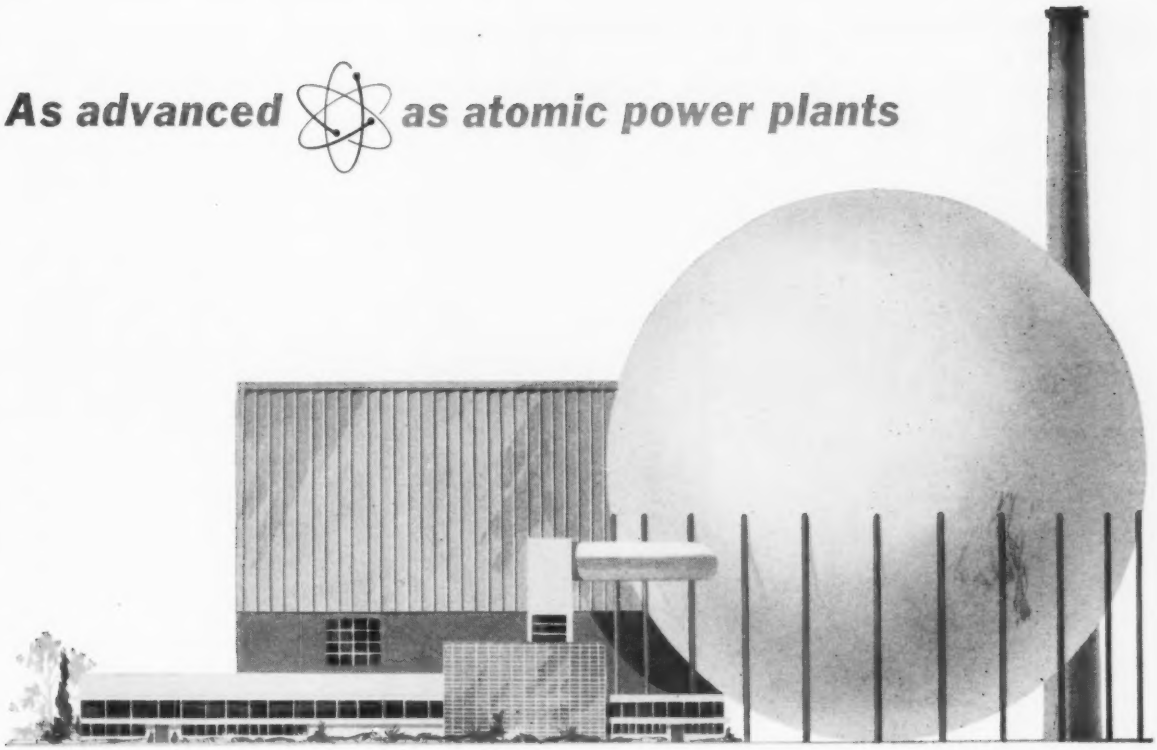
Over 48 tons of steel went into these three stacks

That much carbon steel was used to add 60 ft to each of three stacks, to clear the top of a new building soon to be erected. Built seven years ago at Duquesne Light Co's Elmira, Pa. power station, the original stacks extended 67 ft above the roof. They are 14 ft 6 in. in diameter. The newly extended stacks are 272 ft high.

Each of the new rings has three sections, 8 x 15 ft x ¼ in. Each plate weighs 1350 lb. The stacks are lined with 2½ in. of *Gunite*.

Encouraging more engineering students to enter teaching is the goal of the American Society for Engineering Education. Program calls for fellowships, grants and awards.

As advanced as atomic power plants



INFILCO ION EXCHANGERS

treat boiling water reactor condensate at

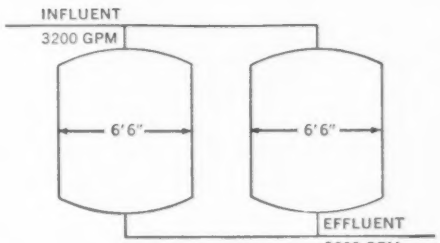
50 GPM PER SQUARE FOOT

Two 6'-6" diameter mixed bed demineralizers with a total surface area of 64 sq. ft. are now being installed to handle 3,200 gpm of reactor condensate. These units will produce polished condensate with a conductivity of approximately 0.1 micromho in a fraction of the space and at much lower installation cost than conventional equipment.

The plant design is based upon extensive pilot plant studies using a 24" diameter unit to treat unfiltered condensate at 200 gpm (68 gpm per sq. ft.). The equipment and techniques developed for this plant are also applicable to high pressure conventional and super-critical pressure plants.

Results of pilot plant studies and design features of this ultra-modern installation will be sent free upon request. Write today for Reprint #88.

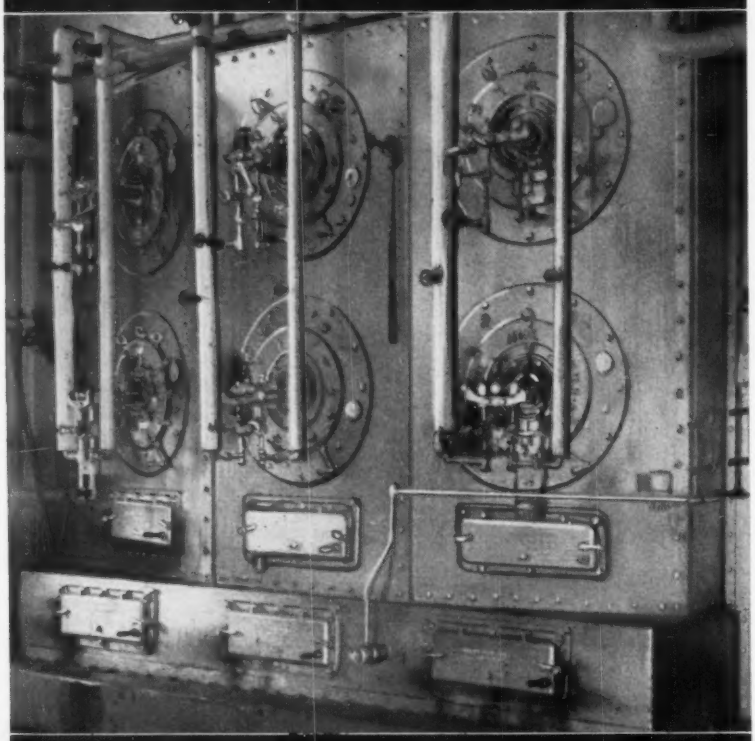
Infilco Inc., General Offices: Tucson, Arizona, P.O. Box 5033
Field Offices throughout the United States and in foreign countries.



INFILCO

THE ONLY COMPANY impartially offering equipment for ALL types of water and waste processing—coagulation, precipitation, sedimentation, flotation, filtration, ion exchange and biological treatment. 58501

Easier CONTROL, *Better* PERFORMANCE



with NATIONAL AIROIL
UNIVERSAL REGISTERS
TYPE "S-A-L"
OIL BURNERS

. . . you get better performance, more economical combustion with NATIONAL AIROIL Universal Registers because they have a dual feature for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disk control. Both adjustments can be made while the Type "S-A-L" Oil Burner is firing.

Another "dual advantage" of NATIONAL AIROIL Universal Registers is that they are equipped for dual fuel firing of gas and oil.

Universal Registers with Type "S-A-L" Burners are available in three (3) sizes . . . capacities up to 60,000 lbs. of steam produced per burner per hour. Write for Bulletin 51.

National Airoil
BURNER COMPANY, INC.
Main Office & Factory: 1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION, 2512 SOUTH BOULEVARD, HOUSTON 6, TEXAS

Technical briefs

Begins on page 141

plated cast iron piston rings have been used. Most of the published data on the use of radioactive piston rings have been with unplated cast iron rings.

Since about three-quarters of the current automobile production is with a chrome-plated top ring, and virtually all of the truck and bus production is with the plated top ring, more attention should be given to the wear properties of chrome plated rings in an iron bore.

But a practical radiotracer system to study this problem could not be developed until the scintillation counter had been perfected. This device provides not only a high counting efficiency for the low energy gamma ray from Cr-51 decay, but also yields output pulses with amplitudes proportional to the exciting gamma ray energy.

Results of controlled tests show the misleading conclusion which was indicated when unplated cast iron rings were used. The assumption that cast iron wear and chromium plate wear are influenced in the same direction by given variables under operating conditions conducive to ring scuffing is not true so far as oil formulation is concerned. *ASLE paper, No. 57LC-3*

Transformers

A user's experience with rectifier transformer failures. *By H O Bourque and E H Coxe, Ethyl Corp.*

Rectifier-transformer failure is different from failure of other transformers. The rectifier transformer is of special design. It usually consists of at least 6-, often 12-phase assemblies in a single tank; while the power transformer is either single or 3-phase.

Because of the severe duty imposed by application with mercury-arc rectifiers, which are subject to arc-back, special internal bracing is built into the units. The character of rectifier load dictates special design consideration in both iron and copper. A rectifier transformer undergoes all the hazards of a regular power transformer, plus a few more peculiar to the application. The failure rate of

Directions for ordering papers on page 210

Stainless-clad surface stays new—keeps coal flowing through bunker noses, hoppers

The corrosion resistant surface of Lukens clad steel *stays new*. Sliding coal actually polishes its surface, keeps it smooth. Costly hangups are cut to a minimum. And clad steel's durability in bunker noses, chutes, hoppers and spreaders is proved by installations 10 years old which show no measurable wear.

Lukens clad steel is not a lining but a solid plate —one side corrosion resistant stainless steel permanently bonded over all to a rugged backing steel.

With clad steel you are assured of ready fabrication, reduced maintenance, freedom from down time, and easy modification. And Lukens will help you and your fabricator select the proper types and gages to meet your needs.

Bulletin 740 will give you performance facts and production information. Send in the coupon and, if you wish, write for the names of experienced coal handling equipment builders. Lukens Steel Company, Coatesville, Pennsylvania.

LUKENS®

Helping industry choose steels that fit the job

GET THIS BOOKLET TODAY!

Manager, Marketing Service
LUKENS STEEL COMPANY
133 Lukens Building, Coatesville, Pa.

Please send me a free copy of your 16-page booklet, "Stainless-Clad Steel for Coal Handling."

NAME _____

TITLE _____

COMPANY _____

STREET ADDRESS _____

CITY _____ ZONE _____ STATE _____

W&T V-notch Chlorinator installed at Esso's Baton Rouge Refinery feeds chlorine at rates up to 500 lbs./24 hr. Units are available with chlorine capacities up to 2000 lbs./24 hr.

NEW W&T V-NOTCH CHLORINATORS,

used at Oil Refineries, are rugged, easy to operate and moderately priced.

Esso Standard Oil Co. has a W&T V-notch Chlorinator installed at their Baton Rouge, La., Refinery. The chlorinator, installed in a small shed open to the sun and weather, chlorinates cooling water for slime control.

This type of installation would be considered rugged service for other equipment but V-notch Chlorinators are designed for such use. They are made of materials that are completely resistant to corrosion as well as weather. They are simple to operate and to maintain. In addition, W&T V-notch Chlorinators are an attractive piece of equipment, colored green to fit into industrial color schemes.

For more information about W&T V-notch Chlorinators, send for bulletin CD-44. 76.

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY

E. R. P. CATHODIC PROTECTION
...INDIVIDUALLY DESIGNED FOR EACH APPLICATION

to prevent corrosion of buried or submerged metal structures

Write for Bulletin E-37

E-37

ELECTRO RUST-PROOFING CORPORATION

30 MAIN STREET, BELLEVILLE 9, N. J.

Technical briefs

Begins on page 144

rectifier transformers has been much higher than that for other types.

This paper does not consider the common causes of failures found in power transformers. It discusses only faults peculiar to the rectifier transformer.

The authors don't imply that the problems have been solved. They do say that it appears that both coil distortion due to magneto-mechanical forces and surges originating in rectifier circuits can contribute to rectifier-transformer failures. Authors are inclined to feel that the latter is the more frequent cause. *AIEE paper, No. CP-58-286*

Economics of design and application of transformers. *By E C Wentz and N Chackan, Westinghouse Electric Corp.*

In today's transformer design, theoretically economic loading is usually possible only for fairly steady loads. Overheating limits the loading for variable load cycles.

The higher loads that are theoretically more economical are not practically usable because of the extreme penalties of overheating and the large impedance voltage drop. The formulas do not take reactive kva into consideration, but under many conditions of service a very large reactive kva is simply not tolerable. If additional cooling were to be contemplated to allow the overloading without overheating, cooling cost would increase to an unreasonable extent.

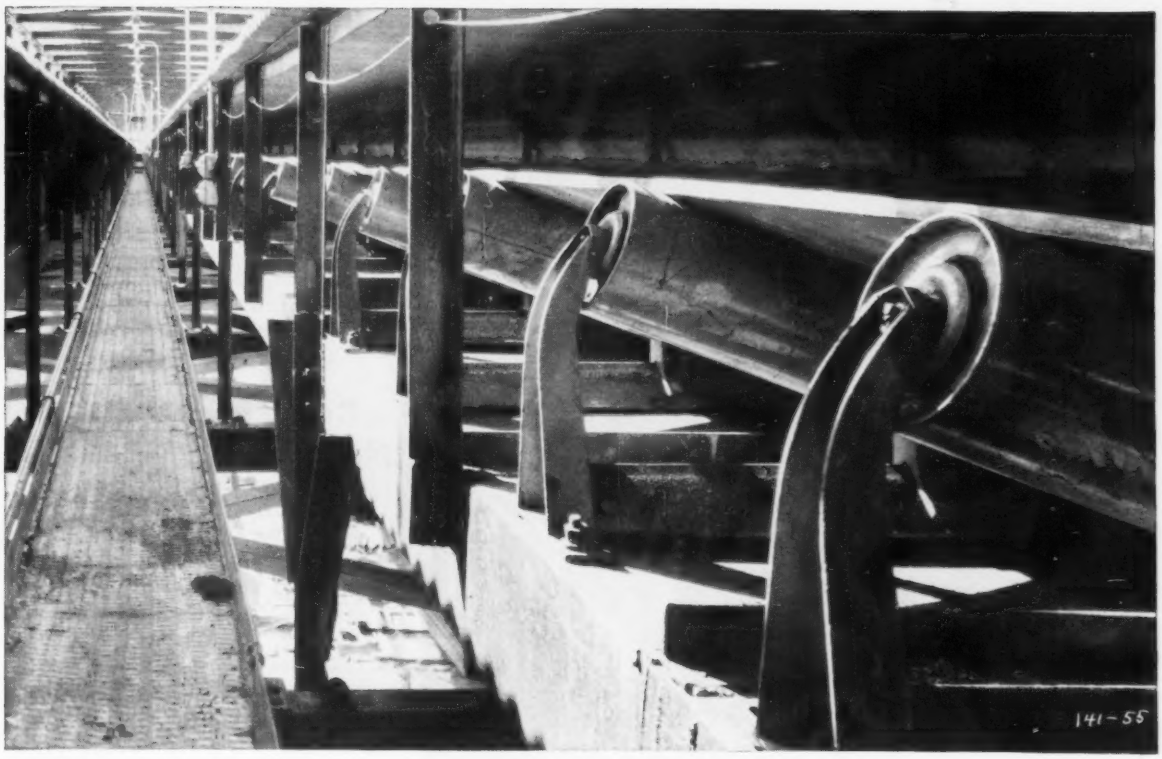
For every 3C increase in copper temperature caused by overloading, the load loss increases 1% because of the increase in copper resistance.

The most economical transformer for a given load is usually about as large as the load. But the transformer is then loaded at less than its theoretically most economic loading. *AIEE paper, No. 58-109*

Temperature rise of dry-type transformers. *By A A Halacsy, H K Porter Co.*

The calculation of the temperature rise of dry-type transformers differs from that of liquid-filled transformers because radiation from the core

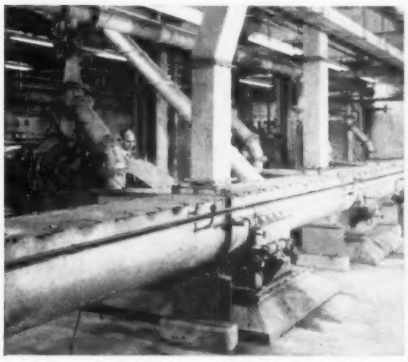
Directions for ordering papers on page 210



Automate your materials handling...
with **Jeffrey** *equipment*

Efficient, dependable Jeffrey conveying equipment is a valuable antidote for rising costs in processes where bulk materials must be moved. PERMASEAL® idlers on these conveyors mean years of usage without greasing—contribute to lower operating and maintenance costs.

Jeffrey products are available through distributors in principal cities. You'll find these men *production-conscious*, ready and willing to advise on your conveying needs. For this help, see them or write The Jeffrey Manufacturing Company, 932 North Fourth Street, Columbus 16, Ohio.



Jeffrey spiral conveyors are available in many styles for moving dry, bulk materials. Compact, they occupy minimum space. Convenient, they can be fed or discharged at any point along their length.

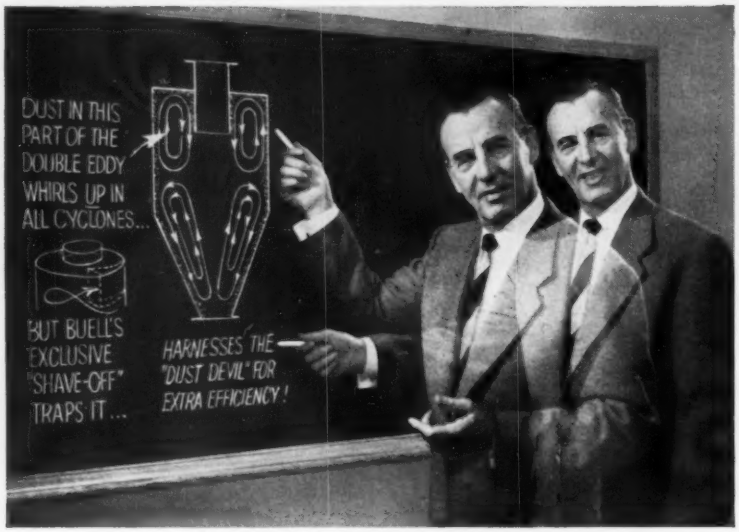
Components of Jeffrey bucket elevators and other conveyors can be constructed to withstand corrosive attack, assuring long life and safeguarding materials handled.

For in-plant conveying or for belts extending across country, Jeffrey PERMASEAL® idlers offer every feature essential to belt protection, dependability and long service.

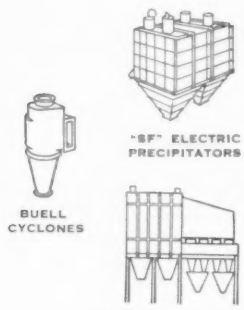
CONVEYING • PROCESSING • MINING EQUIPMENT . . . TRANSMISSION MACHINERY . . . CONTRACT MANUFACTURING

JEFFREY

Mastering the double-eddy dust devil leads to extra dust collection efficiency!


DUST IN THIS PART OF THE DOUBLE EDDY WHIRLS UP IN ALL CYCLONES...
BUT BUELL'S EXCLUSIVE "SHAVE-OFF" TRAPS IT...
HARNESSES THE "DUST DEVIL" FOR EXTRA EFFICIENCY!

Only Buell Cyclones have the "Shave-off" that removes the fines carried in the double-eddy currents, minimizes reentrainment, assures measurably higher dust collection efficiency! Other exclusive extra-efficiency features include *large-diameter* design that eliminates bridging and clogging, proper proportioning for maximum dust separation from the gas stream, extra-heavy-gauge, wear-resistant construction, Buell-designed manifolding that minimizes draft loss, minimizes scouring and eddying. For more information send for a copy of the booklet, "The Exclusive Buell Cyclone." Dept. 50-H, Buell Engineering Company, Inc., 123 William Street, New York 38, N. Y.



buell®

Experts at delivering Extra Efficiency in

DUST COLLECTION SYSTEMS

Technical briefs

Begins on page 144

and coil plays a considerable part in the heat transmission and because the temperature of the cooling air is not as uniform as that of liquids.

Very little, if anything, has been published about calculating temperature rise of dry-type transformers for design purposes. This paper presents a method for such a calculation. *AIEE paper, No. 58-155*

Computers

An optimalizing computer controller for the electric-utility industry. *By L K Kirchmayer, General Electric Co*

This paper describes a computer controller known in the electric utility industry as the General Electric automatic dispatching system. This dispatching system includes analog-computing loops that insure that the turbine-generators within the utility system are loaded according to incremental-cost theories, thus resulting in minimum fuel expenditures. Paper also describes the application of a differential analyzer as a tool in the design of this automatic dispatching system.

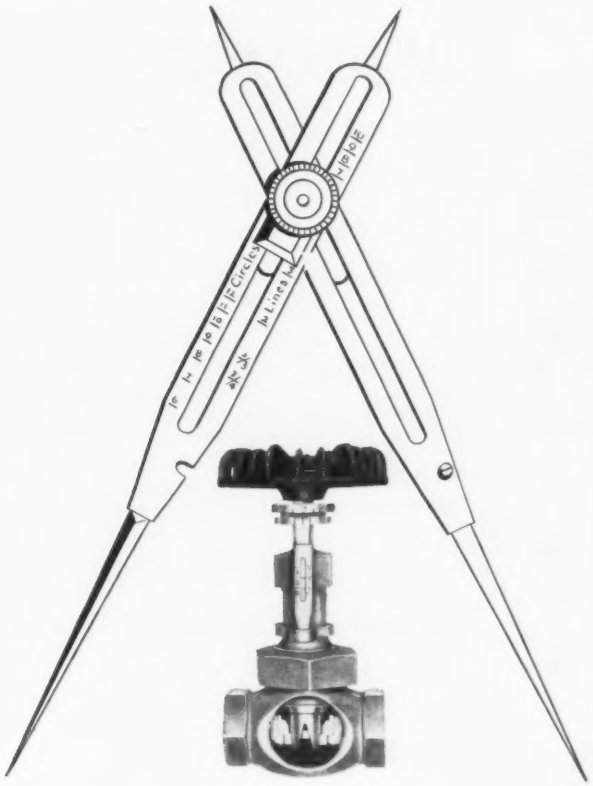
The differential analyzer application includes: (1) complete differential-analyzer simulation of power system and dispatching system to determine optimum design of regulating and economic loops (2) differential-analyzer simulation of a power system tied together with prototype control components to study and evaluate the design of prototype equipment. *ASME paper, No. 58-IRD-2*

Performance computer for steam-electric generating units, Part 1. *By A J Hornfeck and T S Imsland, Bailey Meter Co.*

The next phase in the development of power-plant instrumentation is being directed toward optimization of the power plant and ultimately the entire power-system operation. This involves the use of more complete and accurate basic instrumentation coupled with automatic data-processing equipment.

Two classes of data-processing instrumentation will be required. One

Directions for ordering papers on page 210



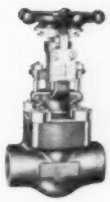
PROPORTIONER

controls flow to save for you

The V-port disc in all Hancock "Flocontrol" Valves insures proportional flow throughout the entire lift of the stem. They are valves that help you achieve uniform product quality through closer control, save steam and fuel on process work, and cut maintenance costs.

"3 in 1" valve design combines variable orifice with shut-off and micrometer dial and pointer. The valve opening can be set within 1/10 turn of the handwheel —you can duplicate all settings easily, instantly. No shut-off valve required—flow is in a straight line, with separate shut-off seating surface located away from the V-ports.

Hancock "Flocontrol" Valves are available in Bronze and Steel to meet the most demanding services. Ask your industrial supply distributor for details.



Hancock "Flocontrol" valves assure positive pinpoint control—eliminate all guesswork.

MANNING MAXWELL & MOORE INC. TRADE MARK

HANCOCK "FLOCONTROL" VALVES

A product of

MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Watertown, Massachusetts

In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

Safe Operation of Overhead Valves

with a

Babbitt

Adjustable
SPROCKET RIM
with Chain Guide

- Simplifies pipe lay-out
- Fits any size valve wheel
- Easy to install and operate
- Operates any valve from plant floor
- Time and money saving fixture
- No maintenance; first cost only cost
- Packed, completely assembled, one to a carton
- Hot galvanized, rust-proof chain available for all sizes
- Easy to follow instructions with each unit

› Your supplier carries complete stocks
› Write for new descriptive catalog sheet and prices

Babbitt STEAM SPECIALTY CO.
BABBITT SQUARE, NEW BEDFORD, MASS., U.S.A.

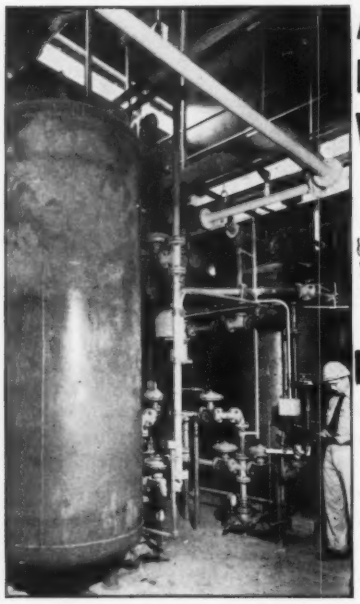
ANY COMPLAINTS?

. . . postal service?
. . . late delivery?
. . . lost copies?
. . . mail gone astray?

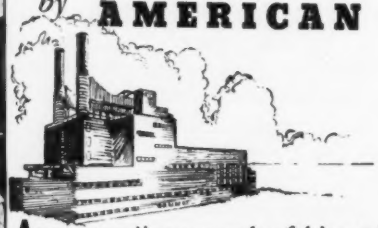
Maybe we don't have your complete address.
A complete address includes a

Postal Zone Number

POWER
330 West 42nd Street
New York 36, N. Y.



AUTOMATIC DEMINERALIZER SYSTEM *with* WASTE NEUTRALIZATION *by* AMERICAN



An outstanding example of this modern development in automatic water treatment is the recent installation of an "American" system by Central Maine Power Company at their Yarmouth Station.

A detailed description will be mailed on request

SINCE 1902

AMERICAN
WATER SOFTENER COMPANY, Inc.

FOURTH STREET AND LEHIGH AVENUE • PHILADELPHIA 33, PA.

DEAERATORS · HOT PROCESS SOFTENERS · ZEOLITE SOFTENERS · DEMINERALIZERS · FILTERS

Technical briefs

Begins on page 144

class will be used essentially for detailed testing and will involve automatic techniques for obtaining many measurements, conversion of data to digital form and the use of digital computers for processing measurement data. Its primary uses in the immediate future will probably be evaluation of new designs and periodic detailed analysis of major units under operating conditions.

The second class of data-processing instrumentation will be used for precise performance determination of the overall steam-electric cycle, and probably also for monitoring the important elements of the cycle including boiler, turbine, condenser and feedwater heater group. This equipment involves the measurement of inputs and outputs and the calculation of heat rates and efficiencies from these measurements. It uses analog techniques throughout, so results are obtained and processed continuously and displayed by indicators and curve-drawing instruments to show dynamic as well as steady-state performance. Output data may be converted to digital form to be logged out periodically on a printing machine to supply data for further analysis. *AIEE paper, No. CP-58-167*

TO OBTAIN COMPLETE TEXT

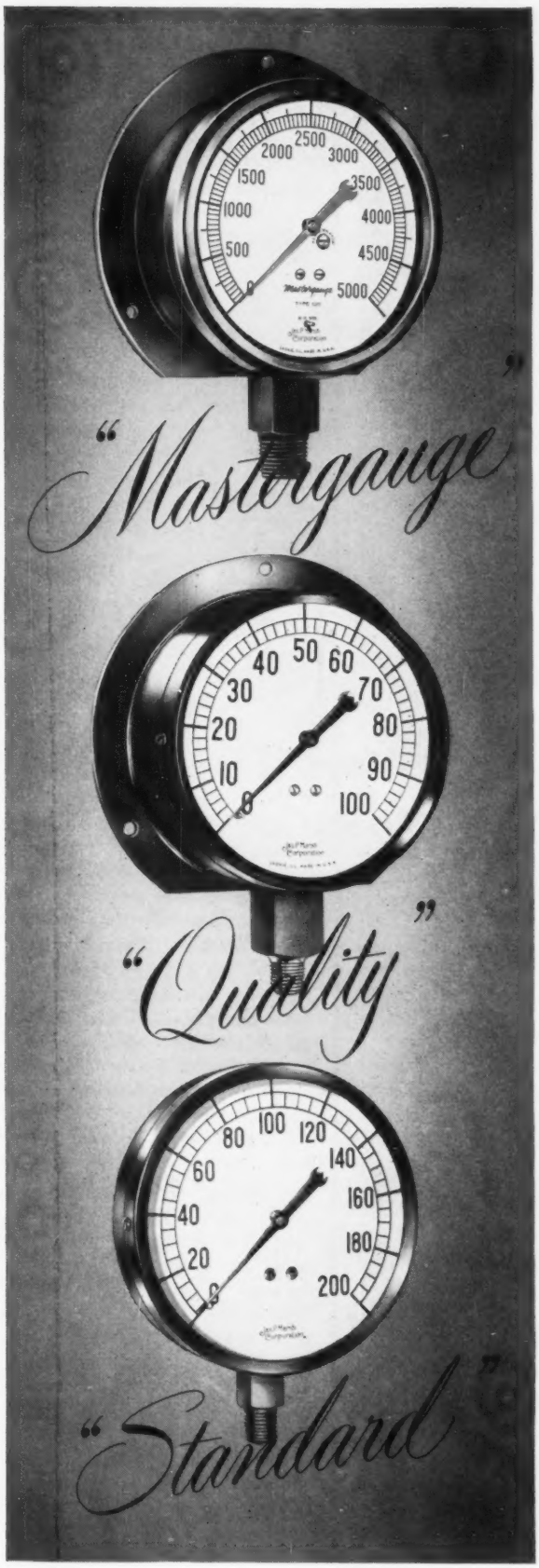
Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not POWER.

American Society of Lubrication Engineers, identified by initials ASLE. Information as to availability from ASLE, 84 E Randolph St, Chicago, Ill.

American Society of Mechanical Engineers. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, New York.

American Institute of Electrical Engineers. Identified by initials AIEE and obtainable through AIEE, 33 W 39th St, New York 18, New York.

Army's Explorer satellite is insulated by Norton Co's aluminum-oxide, a coating similar to material used in grinding wheels and refractory products.



What pressure gauge for your particular need?

The clear-cut economical answer to your specific gauge problem is right here in the Marsh line. It is here because the Marsh line contains the world's most complete range of gauges in the three broad brackets of gauge applications.

THE "MASTERGAUGE" GROUP...for those extreme services that demand the ultimate in gauge precision, accuracy and stamina.

THE "QUALITY" GROUP...also for tough conditions, but less severe than the conditions served by the "Mastergauge" Group.

THE "STANDARD" GROUP...for the general run of pressure gauge services.

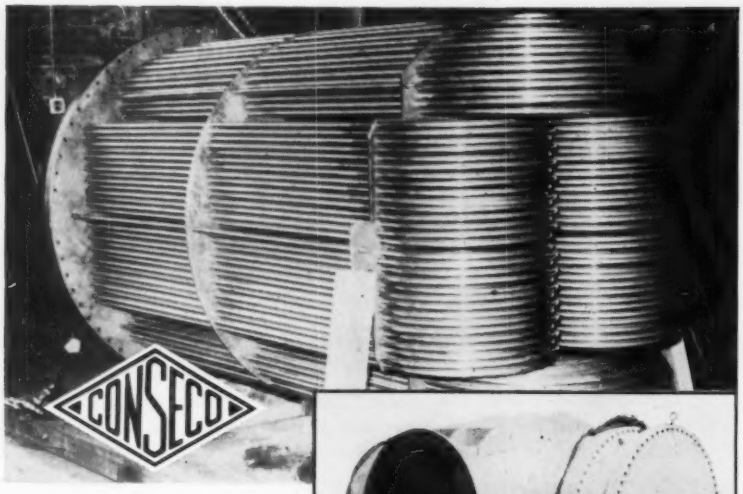
While these three brackets run a wide gamut of prices, the difference between them is not so much a matter of *grade* as a matter of *kind* and *purpose*. All gauges in all groups reflect Marsh precision and quality. Collectively they cover practically every conceivable gauge requirement.

The answer is in the catalog...but if you have a special problem let our engineering department work with you to select the most efficient, most economical solution to your problem.

MARSH INSTRUMENT CO.
Sales Affiliate of Jas. P. Marsh Corp.
Dept. F, Skokie, Illinois.
Marsh Instrument & Valve Co., (Canada) Ltd.,
8407 103rd St., Edmonton, Alberta, Canada.
Houston Branch Plant, 1121 Rothwell St.,
Sect. 15, Houston, Texas

MARSH

"THE STANDARD OF ACCURACY"



HERE'S ANOTHER EXAMPLE OF

CONSECO

CUSTOM-ENGINEERING IN TUBULAR EQUIPMENT

This special Feedwater Heater with U-Bend tubes was designed, engineered and fabricated in the CONSECO SHOPS. It demonstrates that no matter what your requirements in tubular equipment, CONSECO'S more than 30 years' engineering experience and facilities guarantee complete satisfaction.

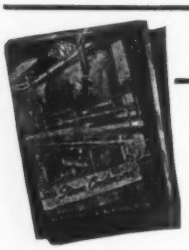
Our recent delivery of a 45,000 sq. ft. Condenser for the Power Plant of the New York City Transit Authority, completely fabricated in our shops, is another sound argument for placing your confidence in CONSECO—confidence both in dependable engineering and greater ultimate economy in terms of performance and maintenance.

CONDENSER SERVICE & ENGINEERING CO., INC. CONSECO

Designers and Builders of Equipment for Power, Refining, Chemical and Marine Industries

164 OBSERVER HIGHWAY
HOBOKEN, N. J.

Hoboken: OLdfield 9-4425 New York City: BArclay 7-0600



◄ Send for this CONSECO Steam Condenser Bulletin

For more data consult Chemical Engineering Catalog pages 559-562

Conseco Designs, Builds, Engineers

All Evaporating, Feedwater Heating, Condensing, Air Removal and Condensate Cooling Equipment required in any Thermal Power Generating Plant.

Condensers • Evaporators • Deaerators • Converters
Feedwater Heaters • Steam Jet Air Ejectors

Bookshelf

Basic Electrical Engineering. *By A E Fitzgerald, Jackson & Moreland Engineers and D E Higginbotham, Tufts University. 540 pp. $7.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

This latest edition places approximately equal emphasis on the four main subdivisions of electrical engineering: circuit theory, machinery, industrial electronics and measurements and feedback control.

Starting with simple statements of the elementary electrical principles stemming from classical scientific experiments, the authors present fundamental methods of analysis which are of significant importance in each of the four fields covered.

Electricity and Electronics—Basic. *By W B Steinberg and W B Ford. 245 pp, illust. $4.50. American Technical Society, Chicago, Ill.*

This interesting and readable book is a very elementary introduction to electricity and electronics. It touches on virtually every major application today. Intended for readers with little or no previous knowledge of electricity, theory is built up step by step. There are review questions with each chapter, and many easily performed projects are described. The numerous illustrations are excellent.

Process Instruments and Controls Handbook. *Edited by Douglas M Considine, Hughes Products Div of Hughes Aircraft Co, and prepared by a staff of specialists. 1286 pp, illust, $19.50. McGraw-Hill Book Co, 330 W 42nd St, New York 36, N. Y.*

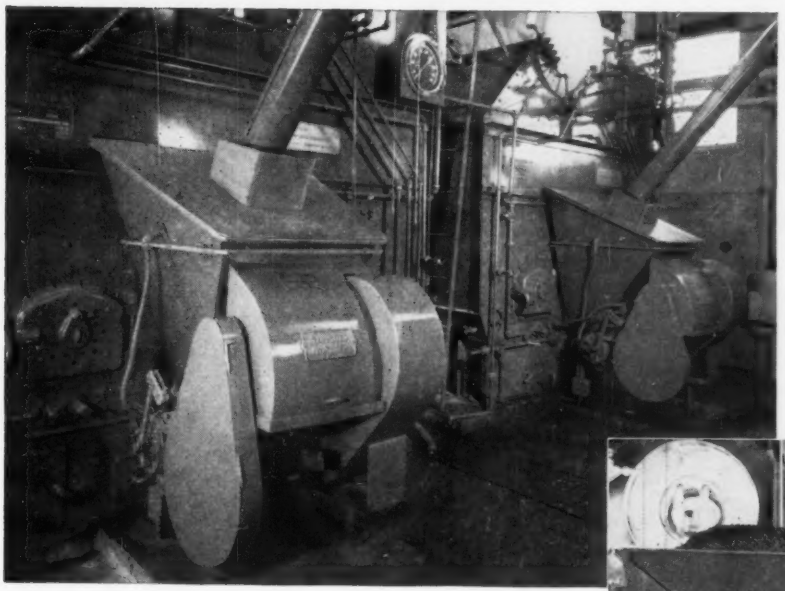
Operating and design fundamentals of measurement and automatic control systems used in the process fields are presented. The book can be used as a review of principles of measurement and control processes or as a guide to selection of instruments and controls for specific jobs. It compiles formulas, constants and other data but does not go into specific industrial application.

Some of the subjects covered are measurement standards, primary elements, measurement systems, indicators and recorders, automatic controllers, timers and program controllers.

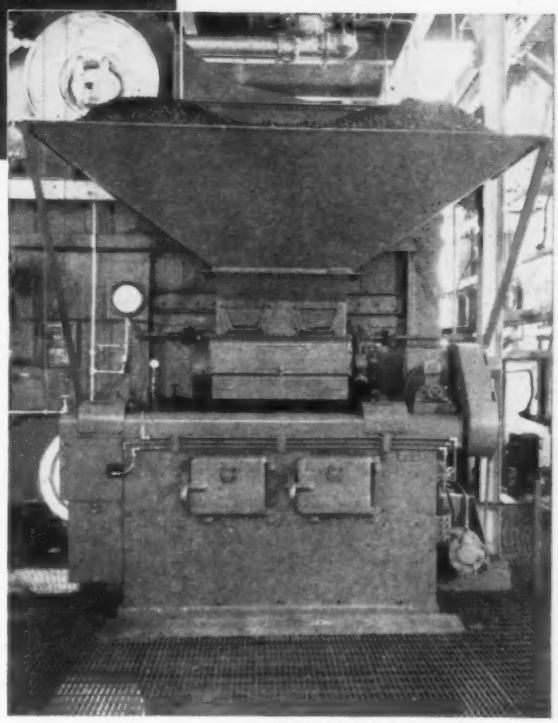
Does Your Package* Include

DETROIT STOKER ECONOMY?

*Package Boilers, of Course



Detroit LoStokers firing two Wickes Package Boilers, Type A.O. continuous rating—6000 pounds steam per hour.



Detroit RotoStoker "CC"—continuous cleaning, Firing Springfield high pressure Package Boiler. Continuous rating—35000 pounds steam per hour. One of five furnished one customer.

As the installation convenience of the package boiler is more and more widely appreciated, the question often is asked "Why can't we have the advantages of a package boiler with the economy of efficient coal firing?"

The answer is—you can. Water tube package boilers designed for stoker firing are readily available.

And a *Detroit* Stoker gets the most economy out of coal, the most economical fuel. This economy plus the exceptional dependability and low maintenance of Detroit Stokers assures you steam at the lowest cost.

The Detroit Stoker line includes a number of types specially adapted to package boilers.

DETROIT STOKERS COST LESS . . . COST EQUALS INITIAL INVESTMENT PLUS UPKEEP PLUS PRODUCTION LOSSES DUE TO EQUIPMENT OUTAGE. THE TOTAL IS LESS WITH DETROIT.

Ask for details on Detroit Stokers with package or other boilers.

DETROIT STOKER COMPANY

MAIN OFFICE AND WORKS • MONROE, MICHIGAN

• District Offices or Representatives in Principal Cities

send for complete specifications on the

WORLD'S MOST COMPACT BOILER

for heating (0-15 lbs.) to process (5-150 lbs.)*

for high temperature hot water for low temperature hot water

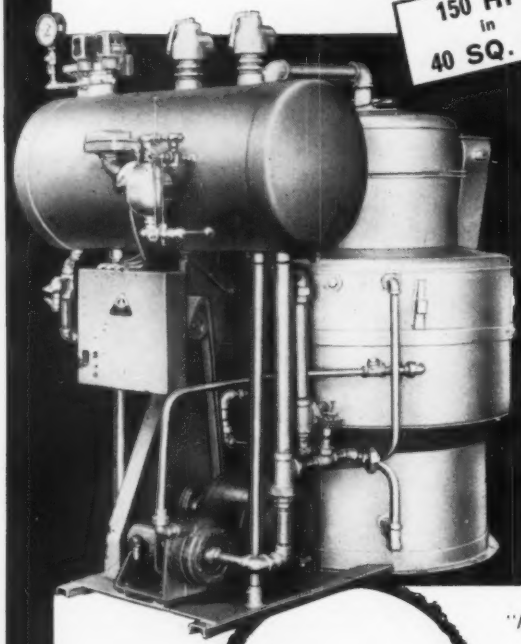
amazing savings in space . . . fuel . . . labor

VAPOR

DRUM MODULĀTIC

WATER TUBE BOILER

150 HP. in 40 SQ. FT.



1/4 the size and weight of other boilers—small enough to fit on a 5′ x 8′ rug with space to spare!

Highest heat transfer and efficiency. Hot gases wipe all tube surfaces.

Fully automatic — delivers full output in 5 minutes, or instant hot water, from a cold start.

Delivered completely assembled, wired and job-tested, ready for immediate operation.

Oil or gas fired or combination oil and gas.

Thousands of Modulatics in use—made by Vapor since 1932, the nation's oldest manufacturer of package steam boilers.

"Money-Maker Series"

Simple Flip Switch
Steam for heating, processing, cleaning, high temperature hot water and many other uses.

Ideal For Multiple-Unit Installation
Coordinated control system turns individual units on and off as needs fluctuate.

*Higher pressures available in other Modulatic models

SEND FOR NEW BULLETIN 475.

VAPOR HEATING CORPORATION
80 E. Jackson Blvd.
Chicago 4, Illinois, Dept. 14-H
Please send me more information about Drum Modulatic for

Individual_____

Company_____

Street_____

City, Zone, State_____

Appointments

Corporation changes

Jeffrey Mfg Co: Frank J Durzo, vice-president. **Development and Resources Corp of New York City:** Walton Seymour, director of industrial development. **Kellogg International Corp:** E F Liebrecht, president. **Kennedy Van Saun Mfg & Engineering Corp:** Earl N Kunkle, vice-president.

Walworth Co: John C Wallace, vice-president, operations. **Controls for Radiation, Inc:** Dr Irving A Bernstein, president. **Pacific Gas & Electric Co:** Shermer L Sibley, vice-president and general manager. **Detroit Stoker Co:** Herbert L Wagner, vice-president and general manager. **Burgess-Manning Co:** S G Paddock, president.

Operations changes

Dravo Corp, Machinery Div: H E Lore, engineering & construction manager. **Joy Mfg Co:** John W Wade, works manager. **Edward Valves, Inc:** Eldon W Menke, manager, tool and plant engineering. **General Electric Co,** Meter Dept: William B Lynn, engineering manager. **Blaw-Knox Co,** Power Piping and Sprinkler Div: W W Weeks, power piping manager. **Yuba Consolidated Industries, Inc,** Yuba Heat Transfer Div: Edward A Bertram, general manager.

District sales manager

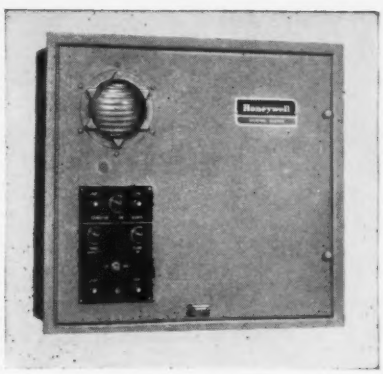
Allis-Chalmers Mfg Co, Industries Group: Clinton F Kucera, New York. **Copeland Refrigeration Corp:** Ray Whitehead, eastern seaboard. **American Air Filter Co, Inc:** Donald H Ninow, Moline, Ill.

Republic Flow Meters Co: Clayton Sivertsen, Chicago; John Dole, Cleveland. **The Trane Co:** Robert W Strickland, Providence, R. I. **John A Roebling's Sons Corp,** Wire Rope & Aircord Div: John P Kadlic, New York; Earl A Frazier, Seattle. **Kelite Corp:** Harry W Kole, Miami and Atlanta; Jacob G Schirtzinger, Ohio. **Allis-Chalmers Mfg Co,** Industries Group: N W Landis, northeast region.

J E Rhoads & Sons: Warren F Decker, midwest; J Warren Mitchell, south. **Sylvania Electric Products Inc,** Sylvania Lighting Products div:

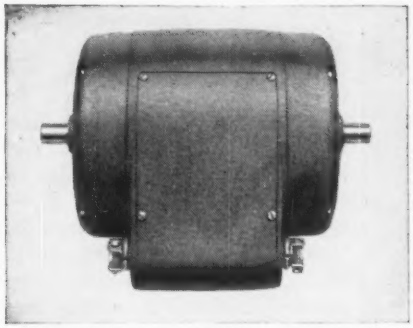
PRESSURE CONTROLLERS for high or low-limit cutoff or signalling, or for control of pressure and vacuum in many ranges from 0 to 1000 psi.

REMOTE BULB TEMPERATURE CONTROLLERS for high or low-limit cutoff . . . signalling . . . and automatic on-off, two-position, floating or proportional control with electrically or pneumatically operated valves, dampers, refrigeration units and similar equipment.

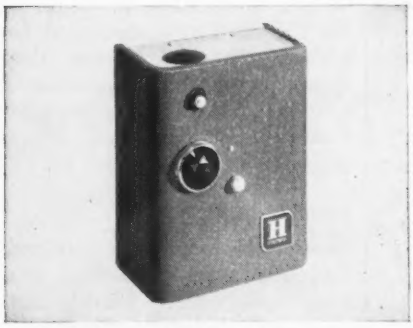


***PROTECTOGLO* FLAME SAFEGUARDS** instantly detect flame failure in gas or oil fired burners, and immediately shut off fuel supply, sound an alarm, and perform other functions to guard against explosion hazards.

Add low-cost automation ...with Honeywell industrial controls



INDUSTRIAL MOTORS for electrical operation of valves, dampers and auxiliary switches.



ALARM SILENCING RELAYS permit an alarm to be silenced, and light an integral red light until an unsafe condition has been corrected. Relay automatically resets the alarm when safe conditions are restored.

You don't have to spend a lot of money for dependable automatic controls. Like many manufacturers, you can use various Honeywell industrial controls as the efficient, low-cost means of automating your equipment . . . improving performance . . . increasing safety. And, you can use these inexpensive controls to save time, money and space by extending automation in your plant or process.

There are more than 9000 standard types of Honeywell controls to handle temperature, pressure, liquid level and humidity—for control, switching or safety functions. There are electric, electronic and pneumatic types.

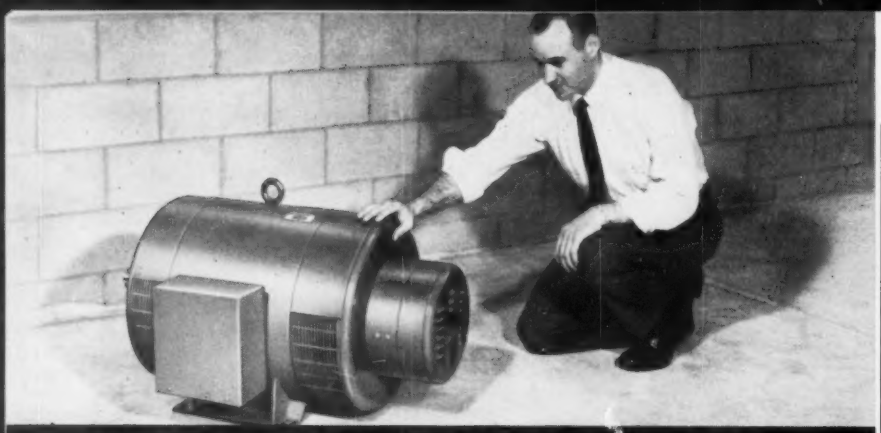
Though they're low in cost, these controls are top-quality, reliable devices. If there's not already a standard control for your particular application, Honeywell can design and build one for you.

Your nearby Honeywell field engineer will be glad to discuss your control requirements. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Philadelphia 44, Pa.

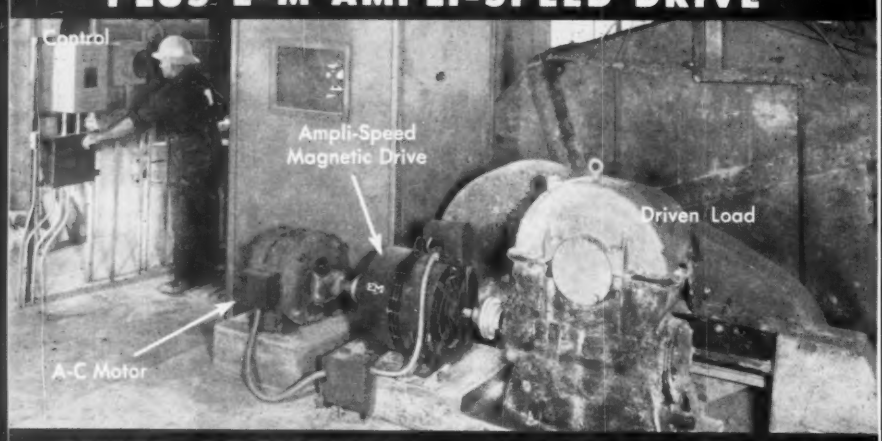
Honeywell

H HONEYWELL *First in Controls*



YOUR CONSTANT SPEED MOTOR

PLUS E-M AMPLI-SPEED DRIVE



GIVES ADJUSTABLE SPEED CONTROL

. . . it's that easy to have precise, adjustable speed control on fans, compressors, centrifugal pumps, conveyors, a-c frequency stabilizers, machine tools, etc.

Ampli-Speed is a simple, compact magnetic slip coupling that is:

EASILY ADAPTED – it may be either belted or coupled to your motor and load.

SIMPLE TO INSTALL – it's air cooled and can be handled and installed just like a motor.

EASY TO CONTROL – speed is changed by simply turning control potentiometer . . . output may be controlled automatically, too, by pressure, level, or combustion devices.

Ampli-Speed gives nearly stepless speed change and holds output speed within ± 2% of that selected. It's available in these integral horsepower ratings: thru 310 hp for variable torque loads; thru 75 hp for constant torque loads. Input speeds can be 860 thru 1750 rpm.

WRITE FOR FREE LITERATURE – Illustrated publication No. 243 tells how Ampli-Speed works and how to select right model from easy-to-use charts. Write the factory for your free copy and see your nearby E-M Sales Engineer for expert help with speed control.

Somewhere in your plant an operation can be improved with adjustable speed control . . . DO IT YOURSELF WITH AMPLI-SPEED

ELECTRIC MACHINERY MFG. COMPANY
Minneapolis 13, Minnesota

Appointments

Begins on page 214

John J Bahnak, Minneapolis. **General Electric Co,** Atomic Power Equipment Dept: Bruce R Prentice, manager of nuclear applications in Europe.

New representatives

For **Assembly Products, Inc:** Brad Thompson, 14915 Rhinestone Rd, Sherman Oaks, Calif.; Electronic Engineering Asso, 1295 Laurel St, San Carlos, Calif.; Technical Sales, Inc, 228 Maple Drive, Fayetteville, N. Y. For **Conoflow Corp:** Darling Co, Box 277, Wheat Ridge, Colo.; E B Miller Co, 6636 Clayton Rd, St. Louis 17, Mo.

For **Solar Aircraft Co:** Southport Engineering Co, 235 W 32nd St, Los Angeles, Calif.; Piepenbrink & Schoonhoven, 3404 N Harlem St, Chicago, Ill.; Power Specialty Co, 2000 Kipling St, Houston, Texas. For **Black, Sivalls & Bryson, Inc:** Hudson Engineering Co, Birmingham, Ala.; North-Monsen Co, Salt Lake City, Utah. For **General Precision Laboratory Inc:** Smith & Purdy Asso, 21 Kearney Rd, Needham Hgts, Mass.; LeeMark Asso, Box 8467, Kansas City, Mo.

Old Dominion Iron & Steel Corp: Parker Devlin Agency, Box 392, Westport, Conn; Plasse Industrial Co, 30 Church St, New York, N. Y.; Merit Steam Specialties and Sales, Box 113, Verona, N. J. For **Belmont Packing & Rubber Co:** Mechanical Rubber & Supply Co, Peoria, Ill. For **Synthane Corp:** Arthur A Carlson & Asso, 7127 Third Ave, S, St. Petersburg, Fla.

Recent purchases, mergers

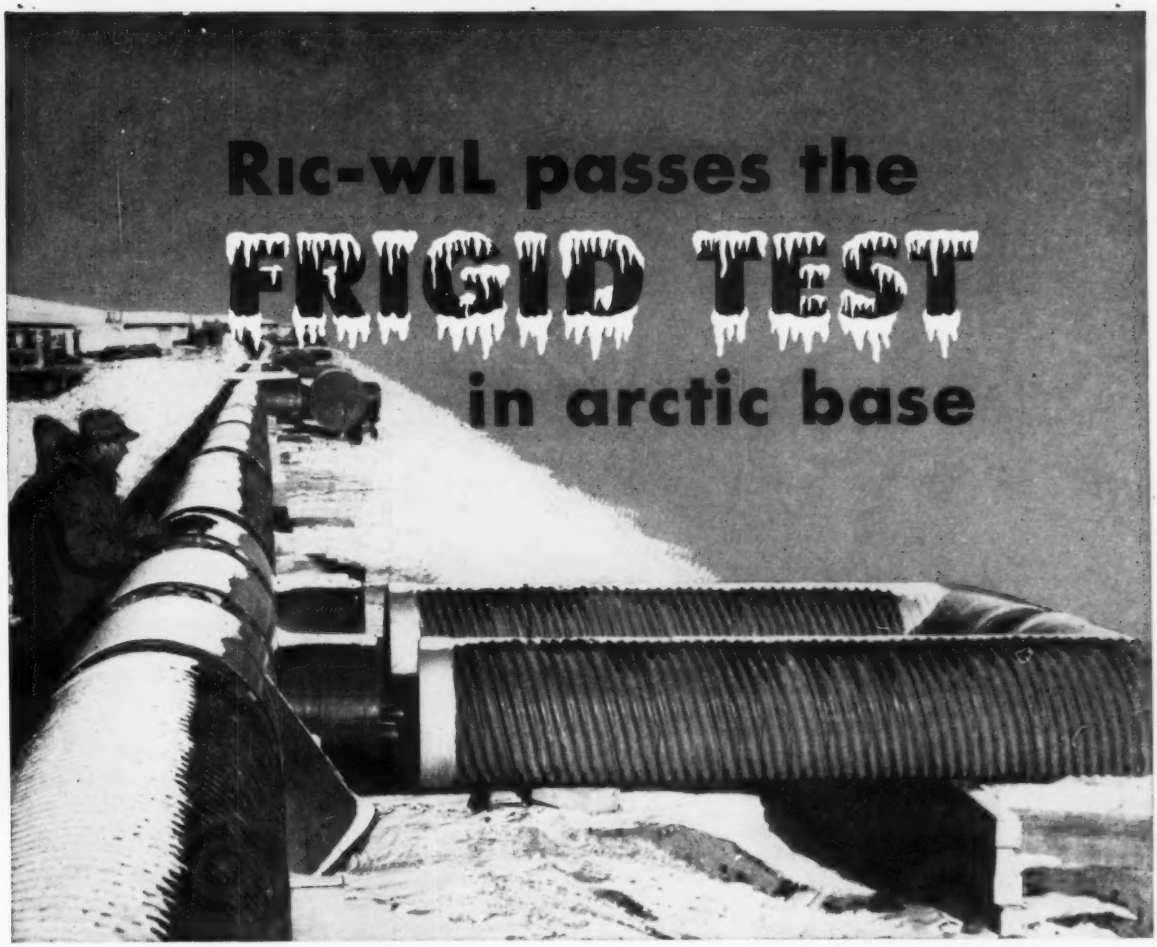
Hagan Chemicals & Controls, Inc: acquisition of name and tangible assets of Kybernetes Corp. **Hein-Werner Corp:** purchase of assets of Tal Bending Equipment, Inc. **Cutler-Hammer Inc:** acquisition of Airborne Instruments Lab, Inc.

Institute Elections

Air-Conditioning and Refrigeration Institute: D V Petrone, president. **Industrial Research Institute, Inc:** Dr Frederick W Stavely, president; Dr R W Cairns, vice-president. **Air Pollution Control Assn:** Arnold Arch, president.

Pipe Fabrication Institute: W

Ric-wiL passes the FRIGID TEST in arctic base



Photograph courtesy U. S. Army Engineers, Eastern Ocean District.

Architect—Alfred Hopkins Assoc., N. Y.
Engineers—Metcalf & Eddy, Boston, Mass. & Guy B. Panero, N. Y.
Contractors—North Atlantic Constructors, N. Y.

The task of building the multimillion dollar Thule Air Base in Greenland confronted the Army's Corps of Engineers with temperatures of 40° below zero.

A Ric-wiL prefabricated insulated system was selected for steam and return distribution lines to feed steam from 40 boilers at 12 different locations. After more than five years of operation the complete system has operated without breakdown. Personnel who man this defense outpost work and live in comfort comparable to stateside duty . . . truly a major accomplishment considering Arctic climatic conditions.

SEE OUR CATALOG IN SWEET'S ARCHITECTURAL FILE OR WRITE FOR COPY

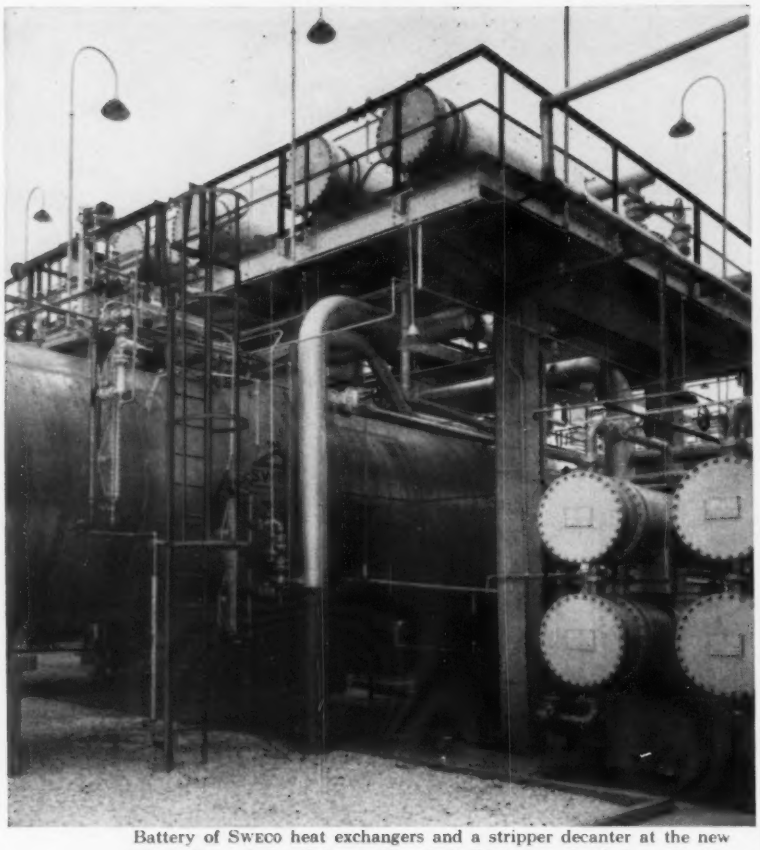
Quality Piping Systems . . .
. . . of Exceptionally High Thermal Efficiency

SINCE 1910

RIC-WIL INCORPORATED — PREFABRICATED INSULATED PIPING SYSTEMS

BARBERTON, OHIO

IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED



Battery of SWECO heat exchangers and a stripper decanter at the new W. R. Grace & Co., Polymer Chemicals Division, polyethylene plant in Baton Rouge, La. Plant was designed and built by the Fluor Corp., Ltd.

Corrosion-resistant Vitals to make High-Purity-Poly

Non-contaminating process equipment by SWECO meets rigid requirements of "most modern" polyethylene plant.

Because of its use in food packaging, the high-density polyethylene produced at W. R. Grace & Company's new multi-million dollar plant at Baton Rouge, La., must be of extreme purity, free from any contamination. All process equipment is therefore fabricated of either aluminum or stainless steel.

SWECO was selected to engineer and fabricate nearly all of the heat exchangers, reboilers, condensers, coolers, decanters–in fact, most of the vital processing units.

Why? Because of SWECO's 40 years experience in making equipment for the process industries – SWECO's facilities and ability in the fabricating of aluminum, stainless steel, copper, nickel, and numerous other alloys – SWECO's reputation for on-time delivery to meet tight construction schedules for plants around the world.

Send for new Catalogs on SWECO Heat Exchangers, Vessels, Steam Jet Ejectors, Surface Condensers, Vibrating Screen Separators and other process equipment. Ask for Data File M-9-393.

SWECO

Southwestern Engineering Company

4800 Santa Fe Ave., Los Angeles 58, Calif.

Engineers & Constructors . . . Manufacturers

Appointments

Begins on page 214

M McKee, chairman. **American Automatic Control Council:** Prof Rufus Oldenburger, president; Dr J C Lozier, vice-president. **Fluid Controls Institute:** Dean E Madden, president; James R Lawler Jr and Fred E Weldon, vice-presidents.

Inter-American Assn of Sanitary Engineers: Thomas P Browne II, president. **Associated Midwest Universities:** Dr James H Jensen, president.

Awards

Dr Arie Jan Haagen-Smit, prof of bio-organic chemistry, California Institute of Technology: Frank A Chambers Award of the Air Pollution Control Assn. **Wilbur A Carter,** Detroit Edison Co; **Kenneth Kugel,** Chief Engineer of Smoke Regulation and Boiler Inspection in the District of Columbia: honorary membership in APCA.

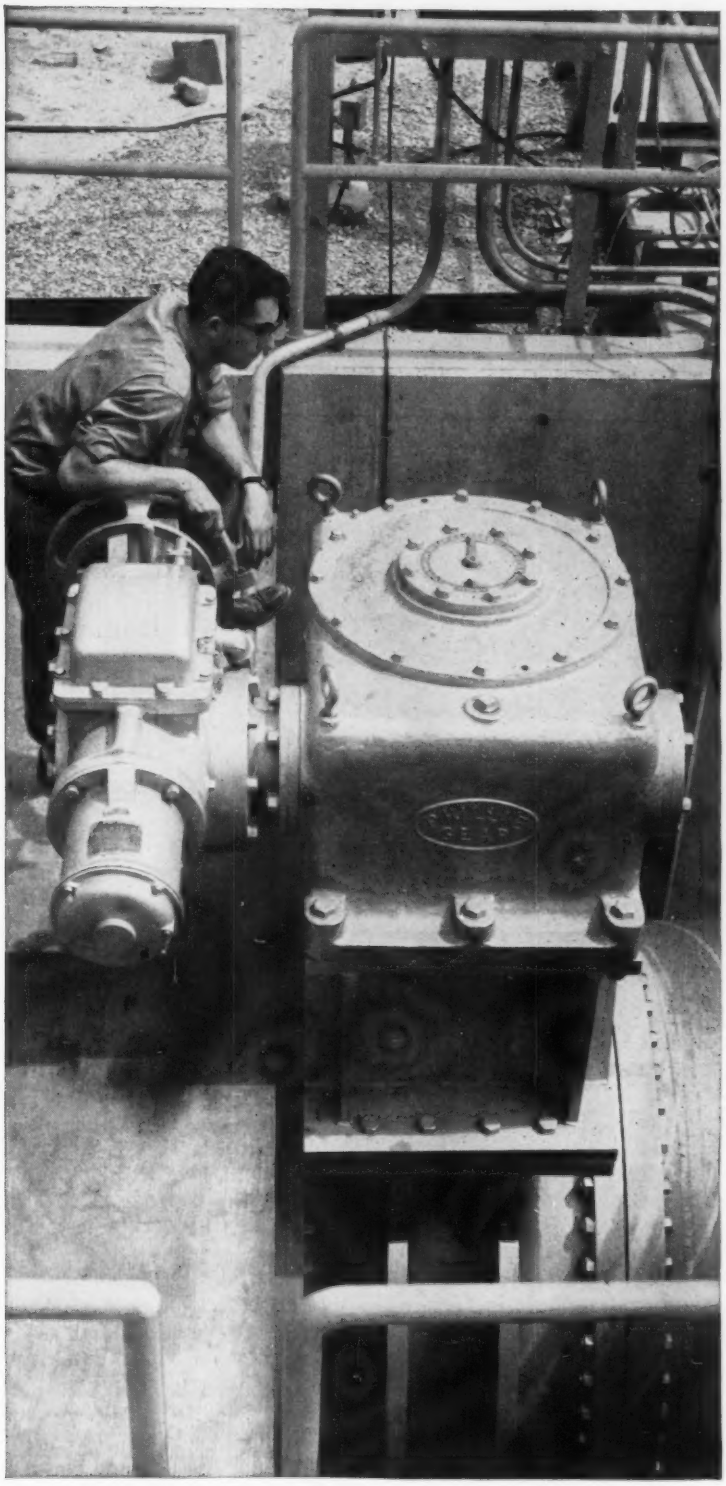
William F Dunkle, Pennsylvania Power & Light Co; **Ingolf B Johnson** and **Charles H Titus** of General Electric Co: elevated to Fellow grade of the American Institute of Electrical Engineers.

Dr Herbert Holloman: Rosenhain Medal of Institute of Metals for work in physical metallurgy.

Engineer changes

Nuclear Development Corp of America: James H Hutton, advisory engineer. **International Nickel Co, Inc,** Atomic Power Developments Section: Marcel A Cordovi. **Cooper-Bessemer Corp:** D L Gallogly, chief engineer.

"Stir those beans, will you. . . . I can't stand burnt beans."



66"

BUTTERFLY VALVE

... installed at

Arnold Engineering Development Center

... operated by

LimiTorque VALVE CONTROL

This large Henry Pratt Co. stressed-seal Butterfly Valve is operated by a type SMA LimiTorque control, in conjunction with a type 1400 VT Philadelphia Reducer. It is one of a number installed in the Ram Jet addition of the Engine Test Facility at the Arnold Engineering Development Center, Tullahoma, Tennessee.

LimiTorque is giving dependable, accurate, and economical service on Valves throughout the World, under all temperatures, pressures, and climatic conditions . . . this is the real test of quality equipment, and is the reason why LimiTorque is so frequently selected over all other types of Valve Operators.

Eliminate guess work and labor . . . choose LimiTorque for operating your Valves.

LimiTorque controls can be field mounted on existing Valves of all types —contact your Valve manufacturer or nearest LimiTorque Sales Engineering Office.

For the full story on LimiTorque's time - and money-saving features, write for Catalog L-550.

LimiTorque®

There is no Substitute for Limitorque

PHILADELPHIA GEAR CORPORATION

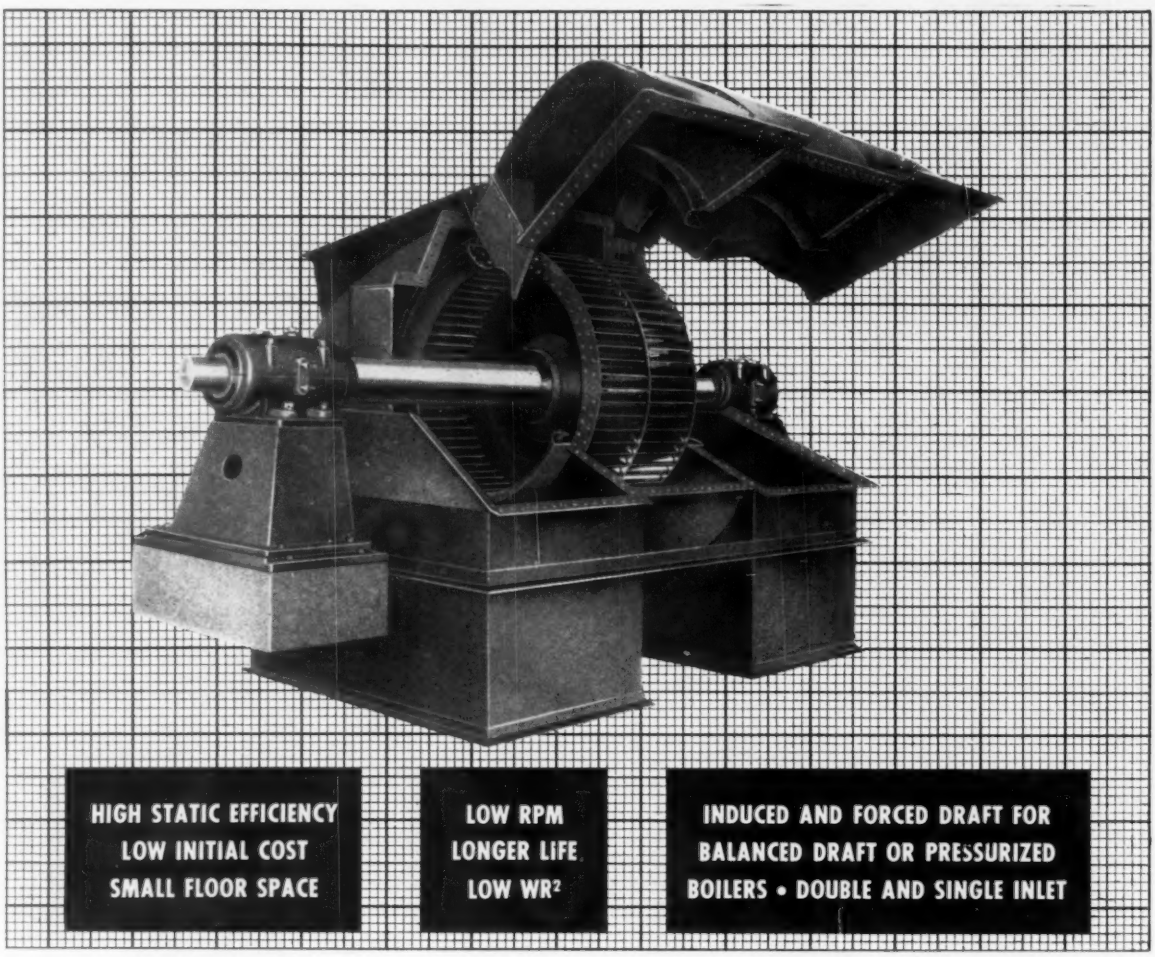
ERIE AVE. & G STREET, PHILADELPHIA 34, PENNA.

Offices in all Principal Cities

INDUSTRIAL GEARS & SPEED REDUCERS • FLUID MIXERS

Limitorque Corporation • Philadelphia

AMERICAN BLOWER SIROCCO FANS



HIGH STATIC EFFICIENCY
LOW INITIAL COST
SMALL FLOOR SPACE

LOW RPM
LONGER LIFE
LOW WR²

INDUCED AND FORCED DRAFT FOR BALANCED DRAFT OR PRESSURIZED BOILERS • DOUBLE AND SINGLE INLET

Look for low initial cost, reduced operating costs, guaranteed performance ratings, minimum maintenance and space requirements. You'll find them *all* in American Blower Sirocco mechanical draft fans.

Specially designed for induced-draft and forced-draft work, Sirocco Fans feature die-formed, forwardly inclined blades for high static efficiency at low rpm's. Streamline, low-turbulence inlets also contribute to high efficiency. And for longer service life, Sirocco Fans have heavy-duty rim and hub plate construction . . . heavy, steel-plate housings and inlets. Special erosion-resistant features are available, as well.

For high efficiency, low cost over the entire operating range, couple Sirocco Fans with American Blower *Gyrol*® Fluid Drive. Infinitely variable in speed, Gyrol Fluid Drive matches fan speed to boiler demand; pays off in longer life for fan wheels and bearings; quieter operation.

If you are investigating mechanical-draft equipment for new or existing installations, take advantage of our experience in air handling. Call your nearby American Blower branch office, today. Or write: American-Standard,* American Blower Division, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

*American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

AMERICAN-Standard
AMERICAN BLOWER DIVISION

Part of the Permutit Precipitator-filter-demineralizer plant treating 2 million gallons of water per day at West Virginia Pulp & Paper Company, Charleston, S. C.

She's only five foot two, but she "operates" these six Permutit Valveless Filters

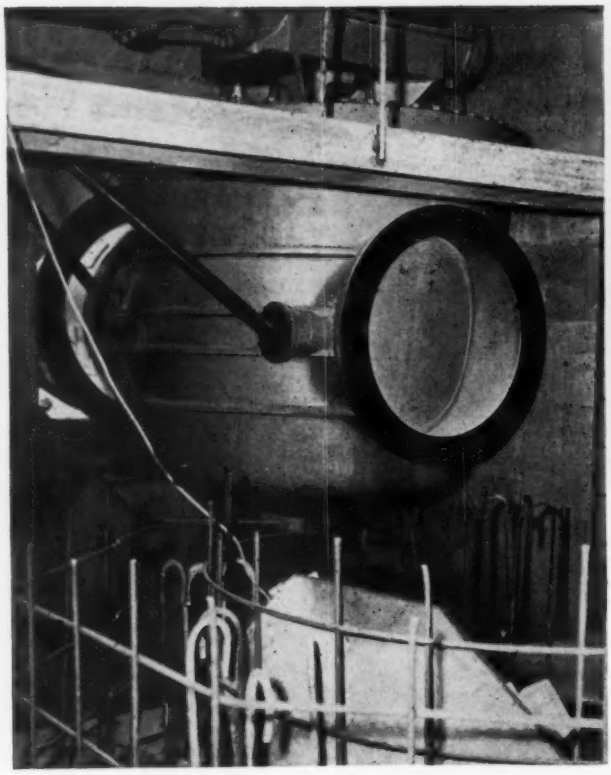
• If these were standard manually-operated gravity filters, it would take 3 husky well-trained men (3 one-man shifts) to open and close heavy valves for shutoff, backwash and rinse. If they were table-controlled automatic filters, the initial cost would be almost *doubled*.

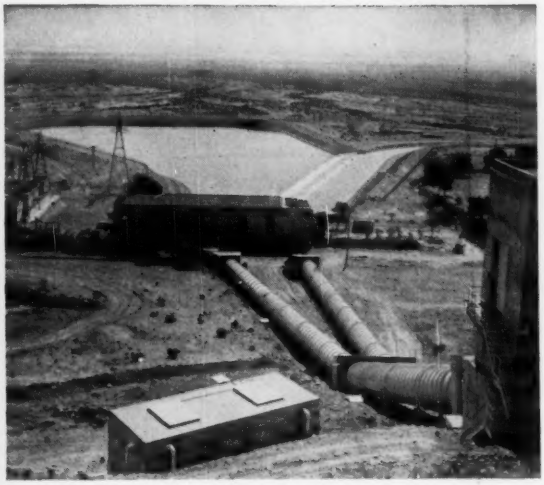
Fact is these filters are in the same price range as manual filters, yet they are *completely automatic*. They shut themselves off from service at just the right bed condition. They backwash and rinse at the most efficient flow rates and for a pre-set length of time. Then they put themselves back into service. The little lady doesn't have to touch them!

Permutit Valveless Filters use a simple design employing basic hydraulic principles to do the "thinking" and the work . . . replacing expensive valves, flow controllers and hydraulic or pneumatic control systems. Initial installations have been approved for treatment of drinking water as well as process water.

Our new Bulletin No. 4351 tells how you can cut both initial and operating costs with Valveless Filters. Call the nearest Permutit man or write to The Permutit Company, Dept. P8, 50 West 44th Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., Toronto 1, Ontario.

PERMUTIT®
rhymes with "compute it"
a division of PFAUDLER PERMUTIT INC.
Water Conditioning
Ion Exchange • Industrial Waste Treatment





▲ Downhill view from Iron Mountain tunnel inlet shows first two conduits and pumping station, with reservoir and aqueduct in background. Excavation at right of pumping station will house third set of pumps, and third conduit will be added.

◀ This SMS-Rotovalve at Iron Mountain shows clearly the drop-tight shut-off position. In operation, the conical plug first lifts, then turns, finally reseats, giving you precise aperture control.

3 MORE SMS-ROTOVALVES ORDERED FOR PUMP DISCHARGE SERVICE AT IRON MOUNTAIN

As part of the expansion program for increasing the supply of water to southern California through the Colorado River aqueduct, three more SMS-Rotovalves have been ordered by the Metropolitan Water District of Southern California. These three 48″ x 64¼″ tapered Rotovalves, duplicates of six already installed at Iron Mountain Pumping Station, will be used for pump discharge service. Their inherent characteristics of a large reduction of flow area during the early part of the closing stroke make them ideally suited to control of surges in the event of emergency shut-off.

SMS-Rotovalves give the least possible pressure loss. In the open position, their full line opening offers no more resistance than a straight piece of pipe of the same diameter. Hydraulic unbalance and mechanical design make operation easy, and less powerful operators may be used. Rotovalves' flexibility suits them to any type of operation, any method of control, or any sort of location.

To obtain information on SMS-Rotovalves, as well as on the entire SMS line of Butterfly and Ball Valves, contact our nearest representative, or write S. Morgan Smith Company, York, Pennsylvania.

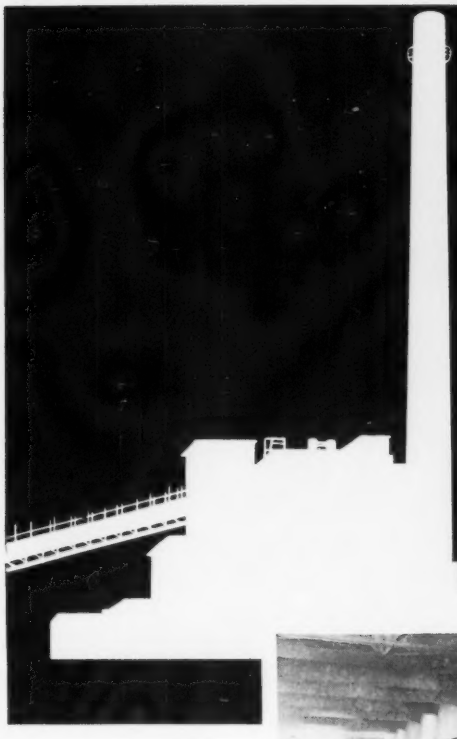
S. MORGAN SMITH HYDRODYNAMICS

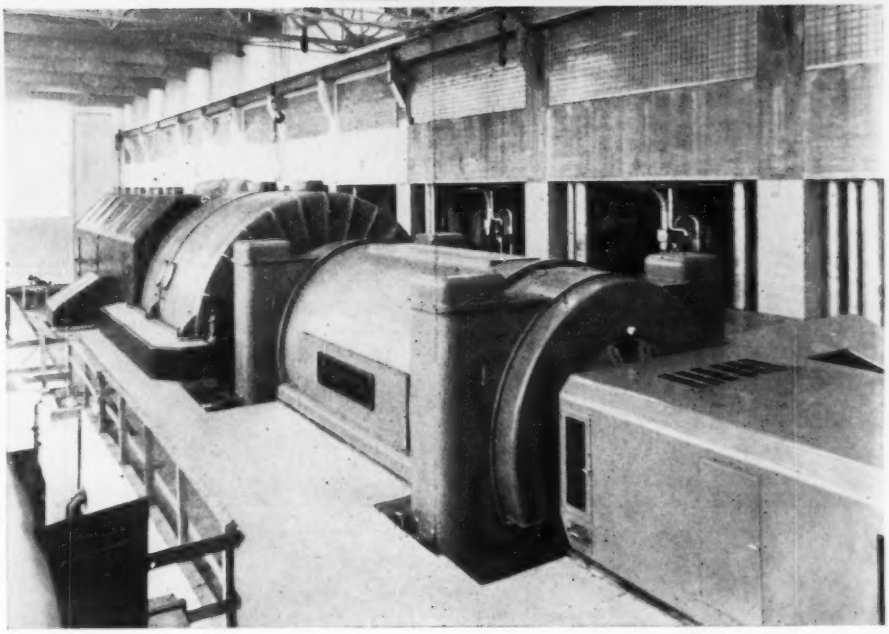
AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

2

Rotovalves • Ball Valves • R-S Butterfly Valves • Free-Discharge Valves • Liquid Heaters • Pumps • Hydraulic Turbines & Accessories

brown boveri
STEAM TURBINE GENERATOR SETS





AVAILABLE SIZES

(Complying with ASME-AIEE Preferred Standards)

11/12.65 MW
20/22 MW
30/33 MW
40/44 MW
60/66 MW
100/110 MW
125/137.5 MW
150/165 MW
200/220 MW
250 MW
300 MW
500 MW

The first of six 150 MW Brown Boveri reheat turbine generator sets in a modern power plant. Many similar and larger units have been in operation for years.

Two of the basic reasons why Brown Boveri turbine generator sets are preferred by economy-minded utility companies . . .

1—*Guaranteed efficiency* is invariably matched (and often exceeded) in actual operation.

2—First cost represents *very substantial dollar savings.*

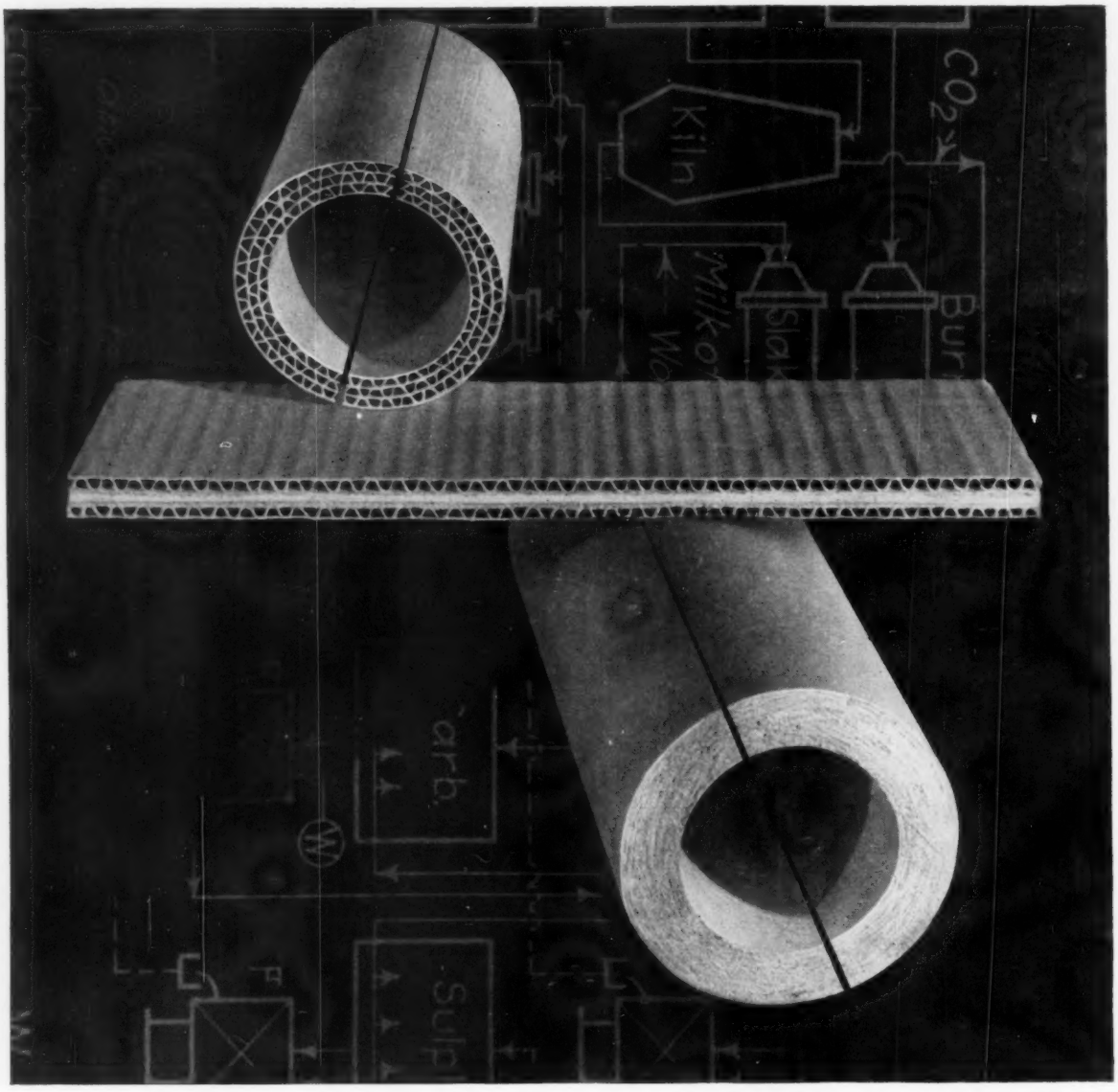
Write for details!

BROWN BOVERI CORPORATION

19 RECTOR STREET —— NEW YORK 6, N.Y.

BROWN BOVERI

Atlanta, Ga. • Birmingham, Ala. • Boston, Mass. • Buffalo, N. Y. • Charlotte, N. C. • Chicago, Ill. • Cleveland, O. • Dallas, Tex. • Denver, Colo. Detroit, Mich. • Hamilton, O. • Jacksonville, Fla. • Kansas City, Mo. • Knoxville, Tenn. • Miami, Fla. • Minneapolis, Minn. • New Orleans, La. • New York, N. Y. Pasadena, Cal. • Pittsburgh, Pa. • Portland, Ore. • Roanoke, Va. • San Francisco, Cal. • San Juan, P. R. • Syracuse, N. Y. • Tucson, Ariz.



In food processing, as in other industries, "K&M" High-Pressure Insulations provide more precise process control.

"K & M" Pipe Insulations provide tighter heat control year after year!

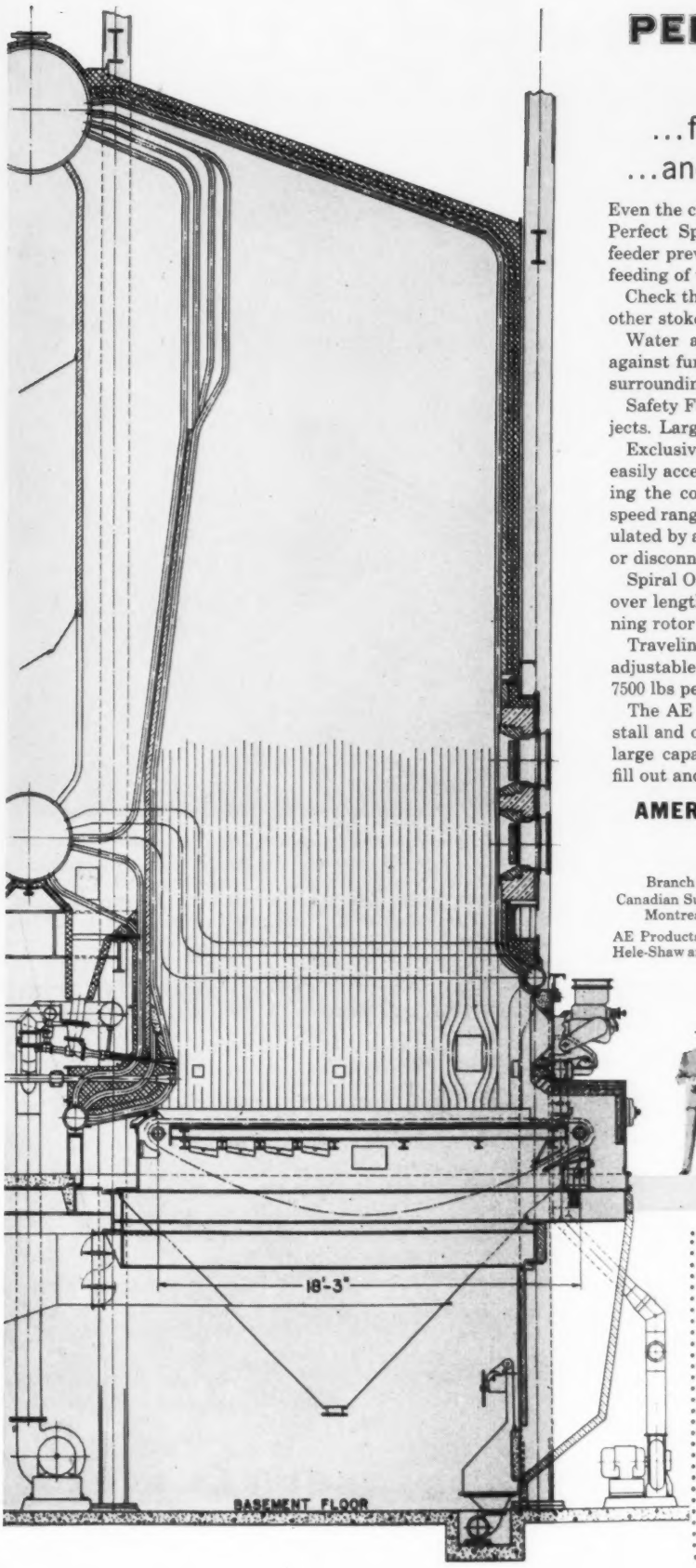
Fuel costs go down, fuel efficiency climbs up, when you install "K&M" High- and Low-Pressure Insulations. They last the lifetime of your equipment. Maintain their insulating efficiency in spite of temperature changes.

You can choose from a wide range of "K&M" High-Pressure and Low-Pressure Insulations: in sheets, blocks, and cements. You can use "K&M" Insulations to keep heat out or keep heat in.

Write to us today for a free brochure which will show you how "K&M" Insulations can give you maximum heat control.

K·M
BEST IN ASBESTOS

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA



PERFECT SPREAD STOKER

...for large capacity boilers
...and large capacity efficiency

Even the cheapest and wettest coal burns evenly in the Perfect Spread Stoker. Exclusive design automatic feeder prevents clogging, guarantees positive uniform feeding of the finest grades of coal.

Check these AE Perfect Spread features against any other stoker:

Water and Air Cooling—Entire feeder protected against furnace temperatures by water and air cooling surrounding furnace opening and rotor bearings.

Safety Features—Prevent damage from foreign objects. Large objects stop feeder or rotor without harm.

Exclusive Traveling Conveyor Feeder—All-enclosed, easily accessible mechanism operates in oil bath, driving the conveyor feeder through a widely adjustable speed range smoothly and quietly. Feeder units are regulated by automatic combustion control, can be shut off or disconnected independently of other feeders.

Spiral Overthrow Rotor—Perfect spread distribution over length and breadth of stoker by continuous spinning rotor of exclusive design.

Traveling Grate—Engineered reinjection system—adjustable overfire air nozzles—coal feed from 50 to 7500 lbs per hour.

The AE Perfect Spread Stoker costs less to buy, install and operate. You get large capacity burning and large capacity efficiency. To get full technical details fill out and mail the coupon.

AMERICAN ENGINEERING COMPANY

Wheatsheaf Lane & Sepviva St.
Philadelphia 37, Pennsylvania

Branch Offices in: Jersey City · Cleveland · Chicago
Canadian Subsidiaries: Affiliated Engineering Corporations, Ltd., Montreal, P.Q. · Bawden Industries, Ltd., Toronto, Ont.

AE Products are: Taylor, Perfect Spread and Vibra-Grate Stokers, Hele-Shaw and Hydramite Fluid Power, Lo-Hed® Hoists, Lo-Hed Car Pullers, Marine Deck Auxiliaries

AMERICAN ENGINEERING COMPANY
Wheatsheaf Lane & Sepviva St., Philadelphia 37, Penna. S-106

Gentlemen: Please send me full information on low cost steam with the

- ☐ AE Perfect Spread Stoker
- ☐ AE Taylor Underfeed Stoker
- ☐ AE Vibra-Grate Stoker

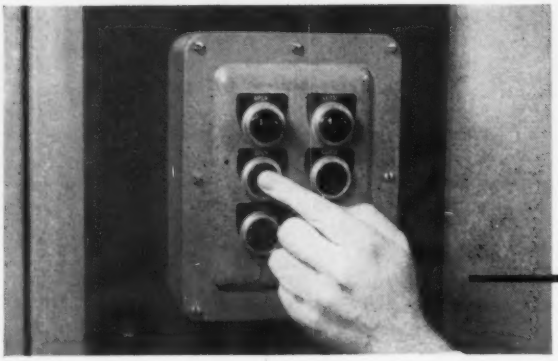
NAME_____ TITLE_____

COMPANY_____

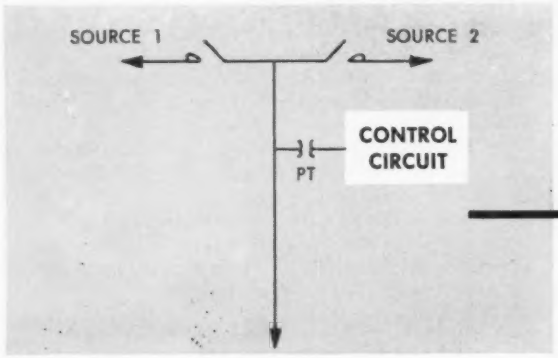
STREET_____

CITY_____ ZONE____ STATE_____

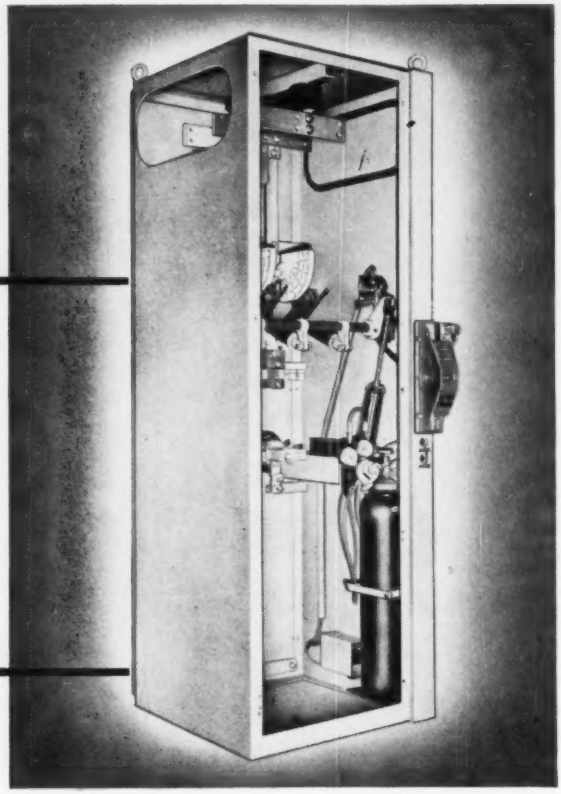
R&IE ELECTRO-PNEUMATIC OPERATOR



Remote-control pushbuttons for switches scattered throughout a plant, or in a number of plants, may be grouped on a single control panel.



Automatic control requires only the addition of relatively simple control circuitry. In the application shown above, the loss of preferred voltage provides the necessary signal for automatic throwover to the emergency source. Only one PT is required in the load circuit.



Electro-pneumatically operated HPL-C Interrupter Switch shown with fuses, phase barriers, and doors removed. Switch can close safely into faults up to a million kva with current limiting fuses. Maximum safety during maintenance is assured by a key interlock which prevents the fuse door from being opened while the switch is closed.

NOW! Lower-Cost Remote or Automatic Power Control

New electro-pneumatic operator provides pushbutton or fully automatic actuation of R&IE 4.8-14.4 kv interrupter switches

Now you can enjoy the efficiency and convenience of dependable remote or fully automatic power switching at a new low cost. The new R&IE electro-pneumatic operator, significantly less expensive than motor driven or hydraulic operators, gives you fast, safe, centralized control of interrupter switches located throughout a plant, or in many plants. Where you require automatic operation, suitable relay circuits can provide switch control as a function of overload, loss of voltage or other special condition.

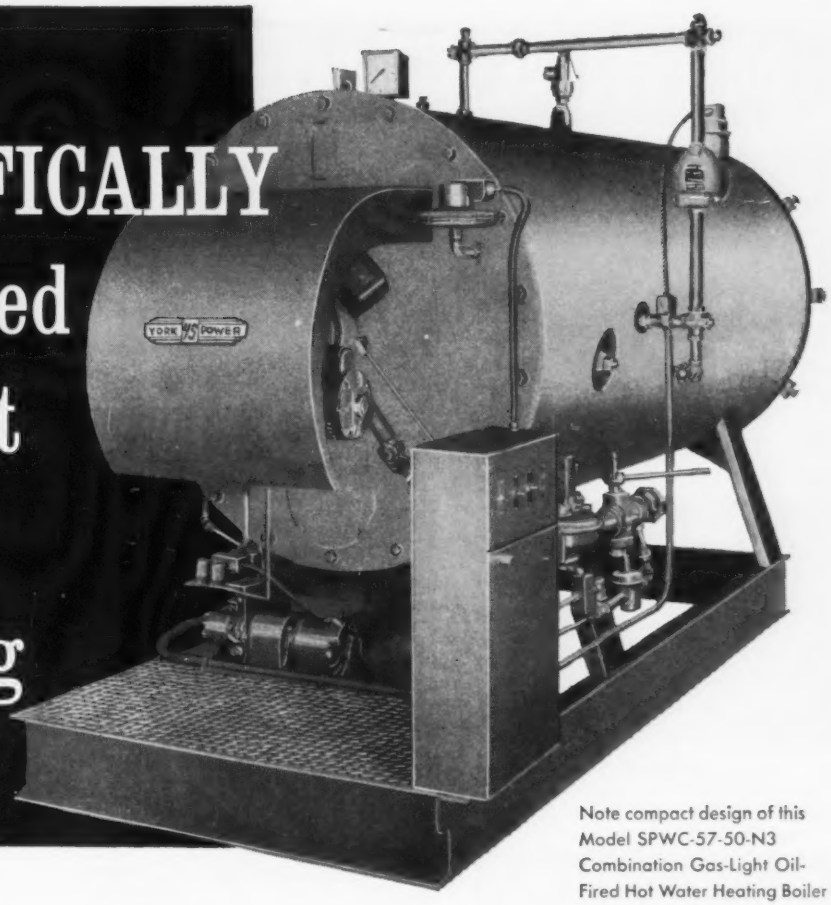
Adequate power for either remote or automatic control can be supplied by a potential transformer. The energy required for positive, high speed switch actuation is developed by a solenoid controlled, double acting, heavy duty air motor located inside the switch cubicle. Pneumatic pressure is supplied by a standard nitrogen cylinder or by dry compressed air from the plant system. One cylinder contains sufficient pressure for at least 500 complete operations.

All new R&IE Interrupter Switches, in ratings from 4.8 through 14.4 kv and 600 through 2000 amp, can be supplied with an electro-pneumatic operator. Many existing switch installations can have electro-pneumatic operators added to them. For complete information, consult your nearest I-T-E sales office or write R&IE Equipment Division, Greensburg, Pa. In Canada: Eastern Power Devices Ltd., Port Credit, Ont.

I-T-E CIRCUIT BREAKER COMPANY

R & I E EQUIPMENT DIVISION • GREENSBURG, PA.

SPECIFICALLY Designed For Hot Water Heating



Note compact design of this Model SPWC-57-50-N3 Combination Gas-Light Oil-Fired Hot Water Heating Boiler

York-Power Packaged Boiler Overcomes Operational Problems for All Types of Hot Water Heating Installations

The use of steam boilers for hot water heating, although accepted, has been inefficient and especially costly from a maintenance point of view because of internal shock and condensation. Now, York-Power engineers have achieved another first—the development of a completely packaged boiler designed *specifically* for hot water heating.

These advanced new units may be used for continuous heat delivery at varying rates of heat flow or for intermittent heat delivery at fixed rates of flow. To serve these two basic systems, York-Power engineers had to face up to and solve new problems not heretofore fully realized.

Here are the solutions:

1. *Elimination of Shock and Condensation* through proper use of mixing valves and an anti-shock control.

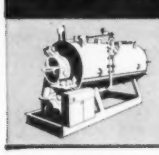
2. *Improved Water Circulation and Air Elimination* by reverse water flow through boiler supply water diffuser tube, and proper air venting.

3. *Lower Installation Costs* with factory-mounted and wired circulator and low-water cut-off and use of all-welded and flanged piping.

In addition, these new boilers mean worthwhile fuel economies because of their unitary design. They operate on gas as well as low-cost heavy fuel oils or lighter fuel oil. Models for combination gas/oil firing are also available.

Now available in 14 sizes ranging from 26 H. P. to 500 H. P. Shipped complete—and factory tested. S. B. I. rated. Use these York-Power boilers on your next heating job. Mail the coupon for complete specifications TODAY!

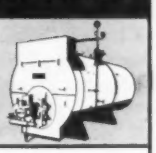
Industrial Division **YORK-SHIPLEY, Inc.** YORK, PA.



STEAM-PAK
15 to 600 Hp.
Oil and/or Gas Firing

PAKETTE
10 to 50 Hp.
Oil and/or Gas Firing

FIRE-PAK
35 to 485 Hp.
Oil and/or Gas Firing



SCOT-PAK
52 to 400 Hp.
Oil and/or Gas Firing

Industrial Division—York-Shipley, Inc., York, Pa.

Please send me new illustrated brochure giving full details about York-Power's new line of Hot-water Boilers.

NAME_____

COMPANY_____

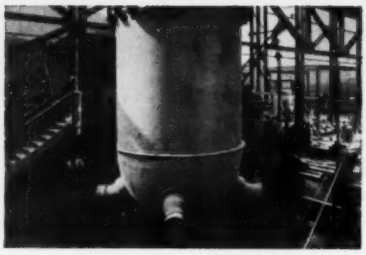
STREET_____

CITY_____ ZONE_____ STATE_____

YOUR FUTURE IS GREAT IN A GROWING AMERICA

ELECTRONICS

Electronics is one of our fastest growing industries. By 1965 there will be thousands of new needs and new jobs.



NUCLEAR ENERGY

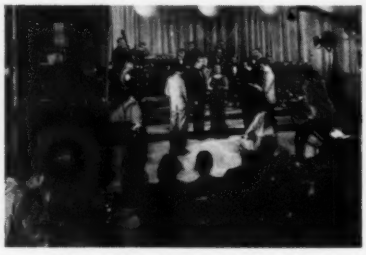
Nuclear energy is now supplying power for ships and electric plants. Future possibilities are virtually unlimited.

HEALTH

Ever-increasing opportunities in research, development and production. In the field of antibiotics 50% more workers will be required.

CHEMICALS

Today there are more than 800,000 workers in chemicals and related industries. By 1970, there will be *twice* as many!



COMMUNICATIONS

As our nation grows, the demands made upon communications grow proportionately. Thousands more needs, more jobs.

EDUCATION

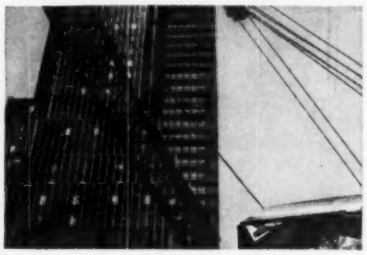
The giant school-building program now beginning will offer new jobs to many thousands of construction workers.

TRANSPORTATION

Our growing population demands constantly increasing mobility. Result: thousands of new opportunities, new jobs in the coming Jet Age.

FOODS

The trend is to labor-saving, ready-to-eat packaged foods. This new phase of an old industry will need thousands more workers.



CONSTRUCTION

3 million workers will benefit from new highway and construction programs—and even more workers will be needed soon.

7 BIG REASONS FOR CONFIDENCE IN AMERICA'S FUTURE

1. MORE PEOPLE—Four million babies yearly. U. S. population has *doubled* in last 50 years! And our prosperity curve has always followed our population curve.

2. MORE JOBS—Though employment in some areas has fallen off, there are *15 million* more jobs than in 1939—and there will be *22 million more* in 1975 than today.

3. MORE INCOME—Family income after taxes is at an all-time high of $5300—is expected to pass $7000 by 1975.

4. MORE PRODUCTION—U. S. production *doubles* every 20 years. We will require millions more people to make, sell and distribute our products.

5. MORE SAVINGS—Individual savings are at highest level ever—*$340 billion*—a record amount that is now available for spending.

6. MORE RESEARCH—*$10 billion* spent each year will pay off in more jobs, better living, whole new industries.

7. MORE NEEDS—In the next few years we will need more than *$500 billion* worth of schools, highways, homes, durable equipment. Meeting these needs will create new opportunities for everyone.

* * *

Add them up and you have the makings of another big upswing. Wise planners, builders and buyers will act *now* to get ready for it.

MARKETING

Marketing includes sales, consumer research, product and package design, advertising and public relations. All need new skills every year—and *many thousands* of new workers!

FREE! Send for this new illustrated booklet, "Your Great Future in a Growing America." Drop a postcard to: ADVERTISING COUNCIL, Box 10, Midtown Station, New York 18, N.Y.

YOUR GREAT FUTURE IN A GROWING AMERICA

PUBLIC SERVICE ADVERTISING COUNCIL

WHERE TO BUY

Featuring additional products specialties and services for power plants

TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers—the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?

POWER — Classified Advertising

PAINTING CONTRACTORS
Specialists in
Power Plants, Refineries, Chemical Plants
HARTMAN-WALSH
5078 Easton St. Louis 13, Mo.

PROFESSIONAL SERVICES

CONSULTING DESIGN EXAMINATIONS PATENTS
CONSTRUCTION PLANS SURVEY • REPORTS TRADE MARKS

BEISWENGER, HOCH AND ASSOCIATES
Consulting Engineers
Surveys, Design, Field Supervision, Power and Transmission, Waste Treatment, Chemical, Civil
Akron, Ohio Jacksonville, Fla. Nashville, Tenn.

THE KULJIAN CORPORATION
Engineers - Constructors - Consultants
POWER PLANT SPECIALISTS
(Steam, Hydro, Diesel)
Utility • Industrial • Chemical
1200 N. Broad St. Philadelphia 21, Pa.

SARGENT & LUNDY
Engineers
140 South Dearborn St., Chicago, Illinois

BLACK & VEATCH
Consulting Engineers
Electricity—Water—Sewage—Industry
Reports, Design, Supervision of Construction, Investigations, Valuation and Rates
1500 Meadow Lane Pkwy, Kansas City 14, Missouri

PETER F. LOFTUS CORPORATION
Design and Consulting Engineers
Electrical • Mechanical • Structural
Civil • Nuclear • Architectural
First National Bank Building
Pittsburgh 22, Pennsylvania

J. E. SIRRINE COMPANY
Engineers
Design Steam & Hydro Reports — Steam Utilization — Consultations Water & Waste Appraisals
GREENVILLE, SOUTH CAROLINA

BURNS & McDONNELL
Engineers—Architects—Consultants
Kansas City, Mo. P. O. Box 7088 Phone DElmar 3-4375

CHAS. T. MAIN, INC.
CONSULTING ENGINEERS
Design—Construction Management
Steam, Hydroelectric & Diesel Plants
Gas Turbine Installations
Transmission—Distribution
Boston Mass. Charlotte, N. C.

STANLEY ENGINEERING COMPANY
Consulting Engineers
Hershey Building, Muscatine, Ia. — 208 S. LaSalle St., Chicago 4, Ill.

GILBERT ASSOCIATES, INC.
Engineers and Consultants
Design and Construction Supervision
Mechanical • Electrical • Structural
Sanitary • Chemical Laboratory
Business and Economic Research
New York Reading, Pa. Washington

PIONEER SERVICE & ENGINEERING CO.
Consulting and Design Engineers
Purchasing
Specialists in
Financing, Accounting Other Operations
231 So. La Salle St. Chicago 4

TIPPETT & GEE CONSULTING ENGINEERS
Mechanical—Electrical—Thermodynamic—Structural
Design—Studies—Supervision
Power Stations—Transmission—Distribution
Industrial Plants—Process
1333 North Second Street Abilene, Texas

INTERNATIONAL ENGINEERING COMPANY, INC.
Engineers
Investigations — Reports — Design
Procurement — Field Engineering
Domestic and Foreign
74 New Montgomery St., San Francisco 5, Calif.

SANDERSON & PORTER ENGINEERS
Construction
Reports *Surveys*
New York New York

WATER SERVICE LABORATORIES, INC.
Specialists in Water Treatment for corrosion Prevention
Main Office:
615 West 131 Street, New York 27, New York
Offices also in Phila., Wash. & Richmond, Va.

"By reason of special training, wide experience and tested ability, coupled with professional integrity, the consulting engineer brings to his client detached engineering and economic advice that rises above local limitations and encompasses the availability of all modern developments in the fields where he practices as an expert. His services, which do not replace but supplement and broaden those of regularly employed personnel, are justified on the ground that he saves his client more than he costs him."

THE J. G. WHITE ENGINEERING CORPORATION
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

SEARCHLIGHT SECTION

(Classified Advertising)

EMPLOYMENT: BUSINESS: **"OPPORTUNITIES"** :EQUIPMENT :USED OR RESALE

UNDISPLAYED ——RATES—— DISPLAYED

$2.10 per line, minimum 3 lines. To figure advance payment count 5 average words as a line. Discount of 10% if full payment is made in advance for 4 consecutive insertions.

Positions Wanted undisplayed advertising rate is one-half of above rate payable in advance.

Box Numbers—count as one line.

The advertising rate is $20.50 per inch for Equipment & Business Opportunity advertising appearing on other than a contract basis. Contract rates quoted on request.

Employment Opportunities—$47.40 per inch, subject to Agency commission.

An advertising inch is measured ⅞" vertically on one column, 3 columns—30 inches—to a page.

Send New Ads to Class. Adv. of Power, P.O. Box 12, N.Y. 36, for September issue closing August 7.

GUARANTEED "REBUILT" POWER EQUIPMENT

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
1750	*G.E.	K	3600
1750	*G.E.	K	1800
1250	*Al.-Ch.	ANX	3600
600	West.	CS	720
600	*G.E.	K-63455	1200
500	*G.E.	K-63455	1200
500	*G.E.	I-13-E	900
350	*G.E.	KT-559-A	1800
300	*G.E.	K6344	1200
250	*W (TE)	CS-81205	1800
250	*G.E.	KT-599-S	1800
250	*West.	CS-875-S	1800
250	Brook	RS28	1200
200	*G.E.	FT-540	3600
200	West.	I-K-13B	1800
200	Brook	CSP-581-S	1800
200	*West.	RS-27	1200
200	G.E.	CS-930-A	900
200	*Al-Ch	KT-564-S	720
200	*West.	AN-37-G	720
200	Al-Ch	CS-1010	600
200	*G.E.	ARW-631	600
150	Cr-Wh	SC-140	3600

SQUIRREL CAGE MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
150	Al-Ch	AN-30-F	1200
150	West.	CSP-5815	1200
150	G.E.	I-K-15A	900
150	*West.	CS	600
125	Al-Ch	AR-226	1800
125	G.E.	5-G	1200
125	Cr-Wh	K-558	900
100	W (TE)	CS-507-S	3600
100	G.E.	FT-542-Z	1800
100	Al-Ch (TE)	ARZ-826	1200
100	Al-Ch	AW-23-D	1200

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

H.P.	MAKE	TYPE	SPEED
2500	*G.E.	MT (Mill Type)	257
1100	*G.E.	MT	720
1000	*G.E.	M-575-S	1200

SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

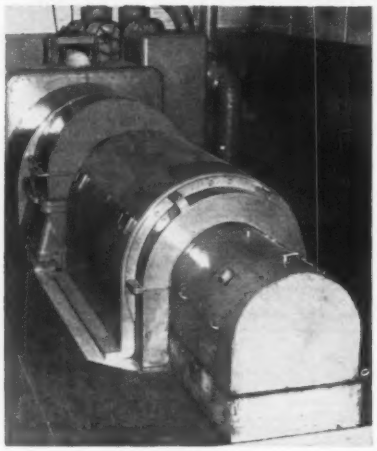
H.P.	MAKE	TYPE	SPEED
1000	*West.	CW	450
600	*G.E.	M-6345-S	1800
500	G.E.	M-6345	1200
400	*G.E.	MTP-585	1200
350	*Al-Ch	ARYW	1800
300	Cr-Wh	SR70-R	1800
250	Al-Ch	ARY-626	1800
250	*G.E.	I-M-17A	720
200	G.E.	I-M-16	600
200	*West.	CW1950A	514
150	Cr-Wh	SR-50R	1800
150	G.E.	I-M-15A	600
125	G.E.	I-M-15A	600
100	G.E.	I-E-13A	1800
100	G.E.	MT358	720
100	G.E.	I-M-15A	425
75	West.	CW-770	1200
75	G.E.	MT-347	1200
75	G.E.	MT-356	900
75	G.E.	MT-352	720
75	G.E.	I-M-10	600
60	G.E.	MT-356	1200
60	*West.	CW-762C	900
50	*G.E.	MT-536	1200

WRITE FOR CURRENT STOCK LIST

CHICAGO *Electric Co.*

ALL TYPES OF EQUIPMENT IN STOCK

1320 W. CERMAK RD. • CHICAGO 8, ILL. • PHONE: CANAL 6-2900



2500 KVA POWER PLANT. Will be sold individually or as a complete unit. **TURBINE** — 9 Stage, Non-Condensing, Automatic Extraction, 600 PSIG, 600° FTT, 150# Extraction, 30# Back Pressure, 3600 RPM, direct connected to **GENERATOR**—2000 KW 3/60/480 Volts complete with Controls. **BOILER** — 4 Drum Bent Tube, 75000 #/hr. 650 PSIG, 650° FTT with Water Walls, Oil Fired complete with Fans and Feed Water Pump. **PRINTS** and Photos available. Write **HEAT & POWER CO., INC., POWER EQUIPMENT DIVISION,** 60 East 42nd St., New York 17, N. Y.

CORROSION ENGINEERS

Several attractive openings are available with a highly regarded, major Eastern engineering company. These positions require Electrical Engineering graduates with 5-10 years experience in corrosion control investigations, corrosion testing and solution of corrosion problems on pipelines, underground cables, power plant structures, piers, wharves, water and oil storage tanks, etc.

These positions offer ample opportunity for professional growth and personal achievement. Considerable travel within the USA with possibilities of some overseas work. We invite you to investigate these opportunities by forwarding a complete confidential resume.

P-8442, POWER
Class. Adv. Div., P.O. Box 12, N. Y. 36, N. Y.

ASSISTANT POWER SUPERVISOR

Midwestern food processing plant wants a graduate M.E. or E.E., 25 to 35 years of age with a minimum of 2 years experience in Power or related field. To be directly concerned with operation and maintenance of complete Power Plant facilities and with the training of personnel. A desire to deal with people and the ability to handle problems dealing with human relations is essential. Give complete details of qualifications in first letter. Write

P-8297, POWER
520 N. Michigan Ave., Chicago 11, Ill.

GET CASH NOW

for your new surplus motors, controls and transformers!

AVAILABLE: NEW MOTORS

Write, wire or phone collect!

AJAX ELECTRIC MOTOR CORP.

FOR SALE — BRIDGE CRANE

Bucket Handling or Standard Operation. Span 60'. Electrics 220/440 A.C.

Manufactured by Whiting Corp. in 1948

EXCELLENT CONDITION!

ARNOLD HUGHES COMPANY

2765 Penobscot Bldg., Detroit 26 • WO. 1-1894

ADDRESS BOX NO. REPLIES TO: Box No. Classified Adv. Div. of this publication. Send to office nearest you.
NEW YORK 36: P. O. BOX 12
CHICAGO 11: 520 N. Michigan Ave.
SAN FRANCISCO 4: 68 Post St.

POSITIONS VACANT

Wanted Power Engineer — Experienced young man capable of taking charge of coal burning power plant, in a medium sized midwest paper board mill. Division of a National Company. Technical background necessary. Please give complete details in first letter. P-8456, Power.

Wanted—University graduate Engineer with at least five years experience operation steam electric generating station for responsible position in Maracaibo, Venezuela. Preference will be given Spanish speaking applicant. Salary dependent on qualifications. P-8319, Power.

Operation & Maintenance—U.S. Airbase (Canada). Central Heat & Power Plant; Steam Distribution. Engineers, Operators & Mechanics. Single Status. State salary requirements with resume. P-8346, Power.

Maintenance Engineer—Far East Electric Utility requires graduate mechanical engineer or equivalent to plan and supervise mechanical maintenance in oil-red generating stations. Ten years experience in utilities is mandatory. Excellent working and living conditions. One year contract with renewal option. Salary commensurate with experience. Submit complete confidential resume to Gilbert Pacific, Incorporated, P.O. Box 1498, Reading, Pa.

SELLING OPPORTUNITY OFFERED

Wanted: Manufacturer's representative to sell our line of high-quality molded long fiber asbestos-rubber gaskets both for original equipment and replacement sales. Need aggressive individual in Chicago, Illinois; Philadelphia, Pennsylvania; Cleveland, Ohio; St. Louis, Missouri; Los Angeles, California; Pittsburgh, Pennsylvania; Boston, Massachusetts; New York City, or Metropolitan Newark, New Jersey. RW 7957, Power.

POSITIONS WANTED

Power Plant Superintendent, age 36, technical education, 12 years experience in the operation, maintenance and plant betterment of turbo-electric power plants. PW-6856, Power.

Sales Engineering Trainee, product engineering experience on steam turbine equipment, age 30, will relocate. PW-8335, Power.

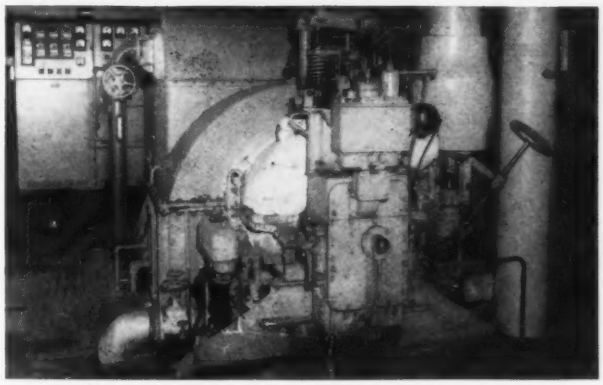
Utility Plant Superintendent. Experienced in construction, start up, plant betterment, personnel training, plant management, operation and maintenance. Desires West. PW-8323, Power.

SELLING OPPORTUNITIES WANTED

New sales engineering group with 15 years experience in sales and application of power equipment interested in representing established related lines in power and processing industries. Presently contacting architects, engineers, contractors and industrial plants in metropolitan New York and New Jersey areas. Men all qualified engineers in power, processing and heating installations, with broad experience in equipment application to all types of process industries. RA-8316, Power.

Manufacturers' Agent, established in 1926 high grade steam specialty lines, northern New Jersey and southern New York Counties, needs reducing valve and temperature regulator; other good repeat lines considered. Charles C. Phelps Company, Inc., 700 New York Ave., Union City, N.J.

2250/2500 KVA General Electric Destroyer Escort Turbine Generator – New 1944



Steam Conditions 440#, 750°, 28" vacuum Electrical Conditions 3/60/2300 Volts, 3800 Sq. Ft. 2 Pass Condenser & auxiliaries, Switchboard & Exciter

IMMEDIATELY AVAILABLE

A COMPLETE LINE OF BOILERS AND DIESEL ENGINES ALSO IN STOCK
Any Additional Data Desired will be Cheerfully Furnished

CHARLES WEAVER, INC.

Cable Address: CHASWEAVER
19701 James Couzens Highway Detroit 35, Michigan
Telephone: BRoadway 3-1900

FOR SALE

STEAM BOILERS

1—30,000 lbs./Hr. Combustion Engr. 450 psi, 825° stoker fired, 1950

SURFACE CONDENSER

1—2500 Sq. Ft Westinghouse, 2 Pass, with aux., 1950

DIRECT CURRENT GENERATOR

1—250 KW, Westinghouse, 250V, 720 RPM, 1950

MOTOR GENERATOR SET

1—25 KW, Westinghouse, 250V DC, 208/120V AC, 1800 RPM, 1950

WATER PUMPS

1—14000 GPM @, 185/370' Hd. De Laval Centrifugal, 690 RPM, 1920
1—20800 GPM, @, 185/370' Hd. De Laval Centrifugal, 720 RPM, 1949

1612 Union Commerce Bldg.

1—24500 GPM @, 185/370' Hd. Worthington Centrifugal, 950 RPM, 1954

STEAM TURBINES

1—1800 HP, De Laval Condensing, 165 lbs. psi 3600/690 RPM, 1920
1—2500 HP, De Laval Condensing, 400 lbs. psi 3600/720 RPM, 1949
1—5200 HP, Worthington Condensing, 175 lbs. psi 3600/950 RPM, 1954

INTERNATIONAL POWER MACHINERY CO.
Cleveland 14, Ohio **Main 1-9514**

REQUIRED FOR LUMBER HANDLING: TWO USED BRIDGE CRANES

One 5 ton 100 foot span three motors, bridge 600 FPM, trolley 250 FPM, hoist 80 FPM, cab mounted under trolley, and one 7½ ton capacity same as above but 70 to 80 foot span. Airmail complete details to:

H. E. BOVAY, Jr., Consulting Engineers
5009 Caroline, Houston 4, Texas

MOTORS AND GENERATORS

1500 HP D.C. MOTORS

1500 HP—525 volts D.C.—600 R.P.M.—NEW—2-bearing continuous duty motors—manufactured by Westinghouse. In original crates. From Navy Destroyer Escort. SPECIFICATIONS: 2-bearing 1500 HP—525 volts DC—2270 amps—600 RPM—ambient temperature 40C—class B insulation—2-bearing pedestal sleeve type—shunt wound—efficiency 94.23%. ONLY 6 AVAILABLE—BUY NOW AND SAVE. Suitable for steel mill drive—offshore oil rigs—rolling mill drive—dredge pump applications.

1200 KW GENERATORS

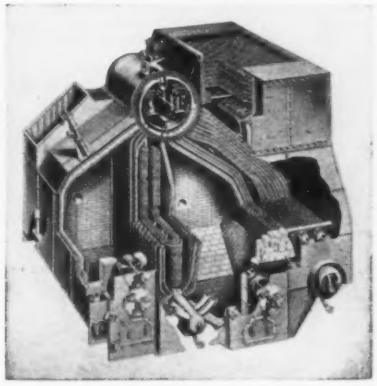
(2) Equal to new—manufactured by Allis-Chalmers. 1200 KW—525 volts D.C.—2290 amps 750 RPM—cooling self-ventilated—totally enclosed—separate excitation—continuous duty—class B insulation—mfg type M.H.C.—frog leg armature.

THE BOSTON METALS CO.
313 E. Baltimore St. **Baltimore 2, Md.**
ELGIN 5-5050 **LEXINGTON 9-1900**

WANTED

Complete power plants, turbo generators, Boilers, Condensers, Engine generators, Processing Plants and equipment.

PAUL OBERMAN
1910 Delmar **St. Louis, Mo.**



16 NEW UNASSEMBLED BOILERS.

B&W, Combustion Engineering, Foster Wheeler. Steel encased. 2 Drum Water Tube with Water Walls, Superheater, Economizer, Soot Blowers, Oil Burners. Complete.

# Steam/hr	PSIG	FTT
153,600	565	850
122,500	565	850
60,000	435	750
44,500	450	735
35,000	285	577

PRINTS and Photos available. Write **HEAT & POWER CO., INC., POWER EQUIPMENT DIVISION**, 60 East 42nd St., New York 17, N. Y.

37 Years Dependable Service

SLIP RING MOTORS 3-Ph., 60 Cy.

H.P.	Volts	Make	Speed
500	4000/2300	G.E.	600
450	440	Whse.	514
400(2)	2300	G.E.	900
400	4000/2300	Whse.	720
300	4000/2300	G.E.	720
300	2300	G.E.	900
300	440	G.E. (holst)	600
300	440	Whse.	3600
225	4000/2300	G.E. (holst)	600
200	2300	G.E.	600
200	2200/440	G.E.	720
150	220/440	Whse.	720
125	2200	G.E.	600

AC GENERATORS or SYN. MOTORS, 60 Cy.

H.P.	Volts	Make	Type	R.P.M.
400	2200/440	G.E.	ATI	720
300	2300/400	G.E.	TS	720
300	2200/440	G.E.	TS	1200
200	2300/440	Whse.	G	1200
150	440/220	Whse.	G	1200
150	440/220	G.E.	TS	900
125	440/220	Whse.	HR	400

SQUIRREL CAGE MOTORS

500	2200/4000	Elliott	SC	1800
400	2300	G.E.	FT	3600
350	2300/440	G.E.	IE-K	1200
300(2)	2200	G.E.	FT	3600
300	2300/4000	L. Allis	FS	1800
200	440/220	G.E.	KT	1800
200	2200	G.E.	KT	1800
200	2200	Cent.	TEFC	3600
200	440/220	G.E.	KT	720
200	2200/440	G.E.	IE-K	1200
150	440	Whse.	X-prf.	3600
150	2200	Al. Chal.	KT	720
150	440/220	G.E.	TEFC	720
150	2200/440	G.E.	AR	1800
150	2200/440		KT	600
150	2200/440	G.E.	FT	1200
125(2)	2200/440	Whse.	X-proof	720
125	2300/440	G.E.	K	600
100(3)	4000/2300	L. Allis	OX	1200
100	2300	Cent'l.	TEFC	3600
75(2)	440	Wagner	TEFC	1800

CIRCUIT BREAKERS, 3 Pole

1—6000 Amp., Whse., 600 V., Air, New
1—2000 Amp., R-Smith, 600 V., Air, New
4—1600 Amp., DA-50, Whse., 600 V., Air
6— 600 Amp., R. Smith, 7.5 KV, Sel. oper.
1— 400 Amp., R. Smith, 7.5 KV, outdoor, New

D. C. MOTORS

H.P.	Volts	Make	Type	Speed
200	230	Cr. Wh.	CMC	1200
150	230	El. Dyn.	B/brg.	600
125	230	G.E.	CD	350

MOTOR GENERATOR SETS

KW	Make	Input V., AC	Motor Type	Output V., DC
250	Whse.	440	Syn.	250
125	G.E.	440/220	Sq. Ca.	125
125	G.E.	440	Sq. Ca.	250/125
100	G.E.	2200/440	Syn.	250
75	Cr. Wh.	440/220	Sq. Ca.	240/120
65	G.E.	2200/440	Sq.Ca.	250

TRANSFORMERS 60 Cy.

1—500 kva. Al. Ch., 2400/4160Y—480 volts, 3 ph.
3—500 kva. G.E., 13,800—300 V.
3—333 kva. G.E., 13,800—2300 V.
3—333 kva. G.E., 2400-240/480 V.
9—300 kva. G.E., 4150—240 V. 3 ph., Pyr.
1—200 kva. Al. Ch. 6900—223 V., 3 ph.
3—200 kva. Whse., 4800/2300—230/115 V.
1—200 kva. G.E., 2400—120/240 V., Pyr.
3—200 kva. Mol. 13,800—2300 V.
3—150 kva. Al. Ch. 2400—230 V.
3—150 kva. Al. Ch. 440-220 V., dry New
3—150 kva. G.E. 13,800—2300 V.
3—100 kva. Whse. 4800/2400-240/480 V., Dry
3—100 kva. G.E., 2400—120/240 V., Pyr.

GASOLINE—ENGINE GENERATOR SETS

1—94 kva 1200 R 220 V 3 ph. Buda, 6 cyl.
SLIGHTLY USED
2—35 kva 900 R 220 V 3 ph. conn. LeRoi, 6 cyl.
only partial listing

STEPHEN **HALL** & CO.
HARRY J. RICE, Pres.
625 ADAMS ST., HOBOKEN 2, N. J.

HIGH PRESSURE STEAM BOILERS

Government Surplus SAVE OVER 75%

NEW, NEVER USED, NEVER ERECTED, AVAILABLE IMMEDIATELY

121,650 Lbs.

1 Foster Wheeler
Express Type, 3-drum, with integral superheater separately fired.
Includes boiler, superheater, economizer, 7 fuel oil burners, soot blowers.
Pressure 634 psi, temp 850° F.
Furnace Vol: boiler 310 cu. ft., superh. 247 cu. ft.

60,000 Lbs.

10 Babcock Wilcox
3 Foster Wheeler
"D" Type, 2-drum, with integral superheater fired between boiler tube bank.
Includes boiler, superheater, economizer, 3 fuel oil burners, soot blowers.
Pressure 435 psi, temp 750°F.
Furnace Vol: 330 Cu. Ft.

We own and stock these boilers. Inspection Invited at Utica, N.Y. Subject to prior sales.

Also on West Coast:
2—122,500# B & W's; 1—74,000# Header Type B & W; 1—60,000# Foster Wheeler

PELNIK-LOCONTI INDUSTRIAL SUPPLY CO.
Office Ph. Utica 6-4621 • 315 Oriskany St., Yorkville, N.Y. • Yard Ph. Utica 2-4513

GUARANTEED ELECTRICAL EQUIPMENT

TRANSFORMERS—1/60—OISC

3—1250 KVA—66,000/22,000/11,000—2300/4000Y V.
3—1250 KVA—12,000—480 Volts
3— 667 KVA—13,800—480 Volts
3— 100 KVA—13,200—2400/4160Y Volts
4— 50 KVA—13,800—2400/4160Y Volts

SLIP RING MOTORS—3/60/440 V.

500 HP— 900 RPM—G.E. I-M—E17B
300 HP—1200 RPM—G.E.—I-M—E15B
250 HP—1200 RPM—Allis-Chalmers
200 HP— 600 RPM—G.E. MT-566
200 HP—1200 RPM—G.E. I-M—E15B
150 HP—1000 RPM—G.E.—MT-557
150 HP— 450 RPM—West.—HF-15A
100 HP— 720 RPM—G.E.—MR-6325Z
100 HP—1200 RPM—G.E.—I-E15
75 HP— 720 RPM—G.E. I-M14

SQUIRREL CAGE MOTORS 3/60/220/440 V.

750 HP—1800 RPM—G.E. FT575
500 HP—1800 RPM—G.E. KTP5654
500 HP—1200 RPM—G.E. KTP567
250 HP—1200 RPM—G.E. IE-15A
150 HP—1800 RPM—G.E. KT-549
150 HP— 900 RPM—G.E. HI-15
100 HP— 900 RPM—West.—MS
100 HP— 720 RPM—G.E. HI-10
100 HP— 600 RPM—G.E. KF-6335Z

MOTOR—GENERATOR SETS

4—600 KW—250/275 V. D.C.—G.E. MPC—900 RPM 3/60/2300/4000 V. Syn. Motor—85% P.F.

SWITCHGEAR—Indoor, Metal Clad
10—600 Amp. G.E.—AM-5-50—Air Cir. Breakers

Rebuilt for immediate shipment in our own modern shop

LEHIGH ELECTRIC & ENG. CO., P.O. BOX 999 WILKES BARRE, PA. VA 2-8118

DIESEL ENGINES — POWER MACHINERY

100 KW to 1500 KW
Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.
MAIN OFFICE: Box 516, Sausalito, Calif. EDgewater 2-1490
BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350

ELECTRICAL POWER EQUIPMENT

A. C. MOTORS—3 Ph. 60 Cy.

SLIP RING

Qu.	HP	Make	Type	Volts	Speed
1	1750	G.E.	M-579BS	4800/2400	1800
1	1500	G.E.	SP706S	4800/2400	1800
1	800	Whse.	CW	550	1778
1	700	Al. Ch.	D.P.	2300	500
1	400	Whse.	CW-432D-15	440	1778
1	500	G.E.	MT-412	2200	439
1	500	Whse.	CW	550	390
1	350	Cr. Wh.	SIZE-715R	208/406	1763
1	350	G.E.	IM-17A	440/2200	720
1	350	Whse.	CW-1030C	440	720
1	250	G.E.	MT-426Y	4000	257
1	250	Cr. Wh.	SIZE-290	2300	950
1	250	A.C.		550	600
2	250	G.E.	MT-563Y	440	875
1	250	Whse.	CW-1010	2200	435
1	200	Whse.	CW-874D	220	885
1	200	G.E.	IE-13B	220	1760
1	200	G.E.	IM	2200	580
2	200	G.E.	IM	2200	435
2	200	Whse.	CW-890	2300	1775

SQUIRREL CAGE

Qu.	HP	Make	Type	Volts	Speed
1	800	G.E.	KT-573	2200	1180
1	500	G.E.	FT-556AY	2300	3600
1	350	Whse.	CS-1115	2300	900
1	500	Whse.	CS-1216	2200	500
2	450	Whse.	CS-1420	4800/4150	354
2	100	Whse.	CS-7151-610H		
1	300	Elliott		6600/4000	3585
1	125	Allis Ch.	BA-684Z	440	1770
1	400	G.E.	AAV-23F8	440	1170
2	200	G.E.	IE	2200	590
2 200/130		Whse.	KT-857	440	1800
1	200	Whse.	CW-9651I	2300	1175/878
1	150	Whse.	CW-1002	2300/400	450
1	150	G.E.	CW	440	580

SYNCHRONOUS

1	7000	G.E.	ATI	2240/6600	600
1	4350	C.W.	3501-WL	13800/6900	514
1	3500	G.E.	TS-6438P	2300/1000	360
2	1750	G.E.	ATI	2300	3600
1	1750	G.E.	TS	2300	900

M-G SETS—3 PH. 60 CY.

Qu.	K.W.	Make	RPM	DC Volts	AC Volts
2	2100/1750	G.E.	514	250/350	2300/4600
1	2000	G.E.	514	660	2300/4600
1	1500	G.E.	720	600	6600/13200
1	1500	G.E.	600	600	2300/4150
1	1000	G.E.	900	250	4800
2	1000	G.E.	720	600	6600/13200
1	750	G.E.	720	275	6600/13200
1	500	Whse.	900	125/250	440
1	350	G.E.	900	125	440/2900/4160
2	300	G.E.	1200	250	2300
1	250	Whse.	1200	275	2300
1	200	El Mby	1200	250	2300/4600
1	300	Whse.	1200	600	2300
1	280	Whse.		550	2300
1	200	G.E.	1200	250	550/3300
1	200	Cr. Wh.	1200	250	440
1	150	Whse.	1200	275	2300
1	100	G.E.	1200	250	4150/2400

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	7500	Whse.	650# condensing, 125# auto extraction, 6900
1	5000	G.E.	400# surface condenser 2400/4150 volts.
1	4000	G.E.	400# surface condenser 2400/4150 volts.

TRANSFORMERS

Qu.	KVA	Make	Type	PH.	Voltages
3	2333	Whse.	OISC	1	13800x2300
3	1000	G.E.	OISC	1	13800x440
1	750	G.E.	FUR	1	4800x38/55
3	500	KUHL	OISC	1	13800x2000
1	225	Marcus	Air	3 auto	208/220
3	100	G.E.	OISC	1	2300x2400/4160Y
3	100	Whse.	OISC	1	4600x460/230/115

FREQUENCY CHANGER SETS

Qu.	KW	Make	Freq.	Voltage
3	6750	G.E.	60/25/60	13200/13200
1	5000	G.E.	60/50/60	11000/6600
3	2500	G.E.	25 cy/62.5	2300/2300
1	500	Al. Ch.	25/60	11000/2300
1	300	G.E.	60/3000	440/880

COMBINATION MILL DRIVES—
D.C. MOTORS WITH M.G. SETS & CONTROLS
PACKAGE DRIVES IN STOCK

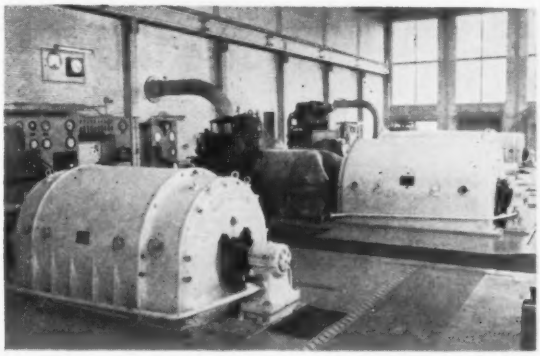
1—2250 HP Elliott 300 V. 200/300 RPM DC Motor with 2400 KW GE MG Set. 300 V. DC 2300/4600 V. 450 RPM 3 ph. 60 cy.
1—1375 H.P. G.E. MCF. 415 V. 1300 RPM D.C. motor with 1100 KW G.E. MG Set 415 V DC, 2300/4000 V. 720 RPM 3 ph. 60 cycle.
1—1300 HP G.E. MPC, 900 V. D.C. Motor, 450 RPM, and 1000 KW, G.E. M-G Set, 600 volt DC with 1400 KP, .8 PF, Synch. Motor 13200/6600 volt, 3 ph. 60 cy.

RE-NU-BILT BY

BELYEA COMPANY INC.
43 Howell St., Jersey City 6, N. J.
Tel: OLDFIELD 3-3334

SPECIAL OFFERING!

650 lb., 725 DEG TURBO GENERATORS — Still on Original Foundations As Shown in Photo Below — All Westinghouse, 3600 RPM, 80% P.F., 6900 V, 3/60.



1—9375 KVA, 7500 KW, 125 P.S.I.G. auto extraction, surface condenser, installed in 1937.
1—9375 KVA, 7500 KW, non-condensing, 125# B.P., installed 1930.
1—6250 KVA, 5000 KW, Condensing, with surface condenser, installed 1942.

•

BELYEA CO. INC.

43 HOWELL STREET **JERSEY CITY 6, N. J.**

N. J. Phone: OLdfield 3-3334
N. Y. City Phone: REctor 2-7150

FOR SALE
14 NEW TURBINES

4 horizontal, 10 vertical, Westinghouse
Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired.
Price reasonable.

Also—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

G. M. De ROSSE
2457 WOODWARD AVE.
706 DONOVAN BLDG.
DETROIT 1, MICH.

DIESEL GENERATOR SETS

1250 KW Cooper-Bessemer Dual Fuel, 1650 HP, 327 RPM, supercharged. Westinghouse 3/60/2300 generator with all accessories. New 1949.

450 HP Fairbanks Morse Model 32E14, 375 KVA. 3/60/2400 volts. With complete auxiliaries. New in 1944.

Both units in excellent condition.
Priced attractively.

WHISLER EQUIPMENT COMPANY
611 Olive St. St. Louis 1, Mo.
CHestnut 1-4474

COAL PULVERIZERS

B & W type E, size 32, 75 HP motor.
RAYMOND #15 Super Mill, 66" dia., 6 roll, 200 HP.
PENNA. CRUSHER, Ring Granulator, 40 HP.

PERRY EQUIPMENT CORP.
1422 N. 6th St., POplar 3-3505, Phila. 22, Pa.

---

2 OIL BURNING BABCOCK & WILCOX WATER TUBE BOILERS

Designed for T2-SE-A2

Now being removed at Philadelphia, Pa., from the S.S. Mission San Francisco.

Complete with deaerating feed heaters, Coffin feed pumps, oil pumps, 1st, 2nd & 3rd stage heaters. Evaporation: normal 43,000 lbs.; max. 60,000 lbs. Designed boiler pressure 700 P.S.I. Final steam temp. at superheater outlet 825° normal. Superheat safety valve setting 624 P.S.I. Boiler heating surface including water wall 6350 sq. ft. Total water heating surface 8030 sq. ft. Economizer heating surface 1680 sq. ft. Operating pressure superheater outlet 600 P.S.I. Furnace volume 573 cu ft. Evaporation rate from and at 212 F lbs/hr/sq ft of total boiler heating surface: Normal 8.33—max. 11.74. Water wall heating surface 118 sq ft. Feed water temp 240 F. Immediate delivery. Presently on barge at Philadelphia. Dimensions: 19'3" high over drum flange: 14' 9-5/16" over casing plate; 16' wide over drum.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD. ELgin 5-5050

5-10-20 HP Gas Fired Boilers
350 HP W. T. Boiler — Gas Fired
4000 sq. ft. Surface Condenser
30 KW Mtr. Gen. Exciter Set — 1952
24" x 250' Belt Conveyors with Motors
150, 50 and 5 Ton Bridge Cranes W/Mtrs.
8' x 160' Cylinders for Coolers/Kilns
600' and 365' Portable Diesel Compressors
H. & P., 6719 Etzel, St. Louis 14, Mo.

1875 KVA POWER PLANT. STILL INSTALLED. Will be sold as complete unit or piece by piece. **TURBINE**—400 PSIG, 700°FTT with Surface Condenser and Pumps, direct connected to **GENERATOR** — 1875 KVA, .8PF, 3/60/2300/3600 RPM, complete with Controls. **BOILER**—25,000 #/hr, 450 PSIG, 738° FTT, Stoker Fired with Superheater, Fans, Feed Pumps. **AUXILIARIES**—Deaerating Heater, Coal Crusher, Elevator and Conveyors. **CRANE**—25 Ton, 36' Span. **PRINTS** and Photos available. Write **HEAT & POWER CO., INC., POWER EQUIPMENT DIVISION**, 60 E. 42nd St., New York 17, N. Y.

FOR SALE
SURPLUS-SACRIFICE-COMPLETE
MODERN HEATING AND STEAM GENERATING PLANT
CONSTRUCTED 1946

Three Combustion Engineering Boilers.
Capacity of each boiler—175,000 lbs. of steam per hour. Each boiler equipped to burn pulverized coal and/or #5 oil.

ONE—Jeffrey Coal Crusher—50 H.P. Motor—440 Volt A.C.

SIX—Raymond Coal Feeders—440 Volt A.C.

TWO—600 G.P.M. Steam Turbine Drive—Boiler Feed Pumps.

ONE—300 G.P.M. Steam Turbine Driver-Boiler Feed Pump.

ONE—300 G.P.M. Electric Drive, Manual Control-Boiler Feed Pump.

ONE—Steam Turbine Booster Pump.

TWO—Brine Pumps.

ONE—120 G.P.M.—one-300 G.P.M. —one 600 G.P.M. Condensate Pumps.

THREE—Permatuit Water Softeners (for boilers).

THREE—Raw Water Filters.

THREE—Oil Filters.

ONE—Duplex Steam Driven Fuel Oil Pump.

ONE—Electric Driven Fuel Oil Pump.

ONE—750,000 Gal. Fuel Oil Tank.

ALBERT J. GROSSER CO.

REALTORS TO INDUSTRY

LEWIS TOWER BLDG. PHILADELPHIA 2, PA.

KINGSLEY 6-1200

MISS POWER EQUIPMENT SAYS,
"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed New and Rebuilt Motors"

SQUIRREL CAGE MOTORS NEW AND GUARANTEED REBUILT

HP	Make	Type	Speed
400	West. B.B. Drip	CSP-681S	1800
400	West. S.B. Open	CS	900
350	A.C. S.S. Drip	ARWW-626	3600
300	G.E. S.B. Open	IK	1800
300	F.M. B.B. Open	H	1800
300	G.E. S.B. Open	IK	900
300	G.E. S.B. Open	IK	720
300	West. S.B. Open	CS-1002	600
250	G.E. S.B. Open	KT	1800
250	F.M. B.B. Open	H	1800
250	G.E. S.B. Open 2200 V	IK-16	1200
250	G.E. S.B. Open	IK	1200
250	G.E. S.B. Open	IK	900
250	G.E. S.B. Open	IK	720
200	G.E. S.B. Drip	K-6326	3600
200	F.M. B.B. Open	H-207	1800
200	Cont. T.E.F.C. B.B.	NP-686C	1800
200	G.E. B.B. Drip	K-6325	1800
200	C.W. B.B. Drip.	SC-86A	1800
200	G.E. S.B. Open	IK-15	1200
200	G.E. S.B. Open	IK-15S	1200
200	G.E. S.B. Open 2200 V	IK	1200
200	G.E. S.B. Open	IK	900
200	English B.B. Open	P-125.5	720
150	G.E. TEFCBB	K-6328	3600
150	G.E. TEFCB XP	K	3600
150	G.E. TEBB	K	1800
150	West. S.S.B. Open	CS-773C	1800
150	West. S.B. Open 2200 V	CS	1800
150	G.E. S.B. Open	IK	1800
150	West. S.S.B. Open	CS-761C	1800
150	West. B.B. Open	CS-771C	1800
150	A.C. B.B. Open	AR	1800
150	G.E. B.B. Open	KT	1200
150	Cont. T.E.F.C. B.B. New		900
150	G.E. S.B. Open	IK	720
150	West. S.B. Open	CS-878A	720
125	G.E. TEFCBB	K	3600
125	West. S.S.B. Open New	CS-607	1800
125	G.E. S.B. Drip	K-505	1800
125	G.E. S.B. Open	IK	1800
125	West. S.S.B. Open	CS	1800
125	A.C. B.B. Open	AR-505	1800
125	El. Dyn. B.B. Drip	KNX-222	1800
125	G.E. S.B. Open	KT-553	1200
125	G.E. S.B. Open	IK	1200
125	G.E. S.B. Open	IK	900
125	G.E. S.B. Open	IK	720
125	G.E. S.B. Open	IK	600
100	A.C. B.B. Open	AR	3600
100	El. Dyn. T.E.F.C.B.B. XP	KNX-223	1800
100	G.E. S.B. Open	KT-343	1800
100	Master, T.E.F.C.B.B.	PA-505	1800
100	A.C. S.B. Open 2200 V	ARX	1800
100	L.A. T.E.F.C.B.B.	JX-113	1800
100	West. S.S.B. Splash	CS-770.3	1200
100	G.E. B.B. Open	K-504	1800
100	G.E. S.B. Open	KT-347	1200
100	West S.B. Open 2200V	CS-774C	900
100	G.E. S.B. Open	IK	900
75	G.E. B.B. Drip.	K-444	3600
75	West. B.B. Splash. 440V	CS-445	3600

CASH FOR YOUR **SURPLUS** NEW & USED Electrical Equipment

•

SEND YOUR LIST TODAY!

FREE CATALOG. This is a partial listing. We are continually changing our stock, and can fill your requirements at any time. Send for our free catalog. In Stock, fractional horsepower up to 500.

Large line of motors. Control Equipment, AC and DC Generators, MG sets and transformers. PHONE or WIRE us COLLECT

POWER EQUIPMENT CO.

8 CAIRN STREET • PHONE BEverly 5-1662 • P O BOX 534 • ROCHESTER 2 N Y

"FASTER FROM FOSTER"

RAIL

& ALL TRACK EQUIPMENT

Nation's Largest Warehouse Stocks

L. B. FOSTER CO.

PITTSBURGH 30 • ATLANTA 8 • NEW YORK 7
CHICAGO 4 • HOUSTON 2 • LOS ANGELES 5

TRANSFORMERS

1—300 KVA, 3/60/4160-240 Wagner, ITE type HPE Unit Substation, Outdoor.
2—250 KVA, 1/60/2400-240/480 Moloney OISC, type YC, with taps
1—225 KVA 3/60/440-208Y/120, Moloney Dry
1—250 KVA, 4—150 KVA, and 2—100 KVA 1/60/4160-240/120 Whse. Inerteen with taps
1—200 KVA 3/60/4160-240 Wagner, ITE type RPB Unit Substation, Outdoor.
3—15 KVA, 1/60/240-480/120-240 Sorgel Dry

CASH

For Surplus Electrical Equipment

BENSON-WILIMZIG, INC.

1708 North 8th St., St. Louis 6, Mo.
Phone GArfield 1-4290

WE PAY $ CASH $

FOR

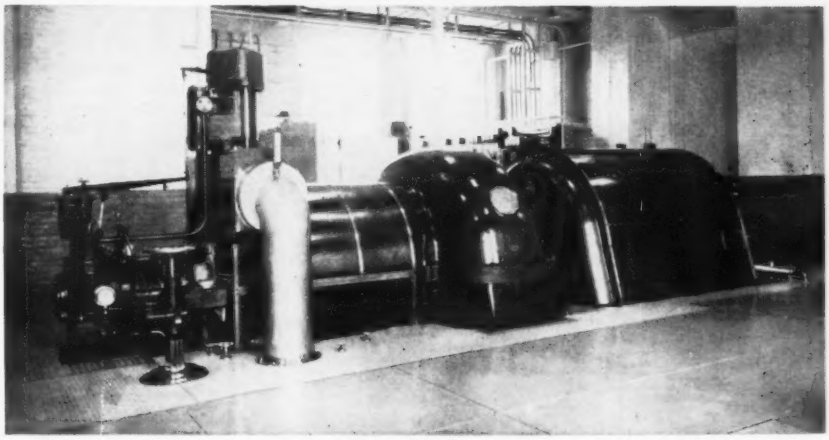
Electric Motors • Starters • Transformers
Circuit Breakers—Electric Supplies

ALLIED ELECTRIC CO.

710 N. MAIN ST., MEMPHIS, TENN.
BOX 1838—PHONE JA 7-1681

BARGAIN OFFERING

6250 KVA—5000 KW, 80% P.F. TURBINE GENERATOR
400 PSIG, 700°FTT 3 PHASE 60 CYCLE 2400/4160 VOLTS



(Actual Photograph Above)

5000 KW, 3600 RPM General Electric condensing turbine generator unit, complete installation with surface condenser, auxiliaries and direct connected exciter. Excellent condition.

UTILITIES MACHINERY CORPORATION

1965 EAST SIXTH STREET TELEPHONES: CH 1-0210 & CH 1-4070 CLEVELAND 14, OHIO

AIRCRAFT FOR SALE

PBY Amphibian Aircraft . . . Only 1400 hours total time completely overhauled and converted to 2 crew handling in 1956. Used almost exclusively on aerial survey work since new, cargo door and floor • Auxiliary power unit • janitrol heater • extremely light weight • excellent condition

Royal Gull Amphibian . . . The world's most economical and versatile "Executive" amphibian • used exclusively as a demonstrator and executive charter ship • only 400 hours since manufacture • new custom exterior paint and customized interior. Available for immediate sale or lease attractive terms.

DeHavilland Beaver . . . Top condition throughout • used solely as an ambulance ship since new • zero time—Pratt & Whitney overhauled engine, new C. of A. Excellent radio and instrumentation • complete with Federal wheel/skiis and Edo floats. Your inquiries are invited.

Bell 47-H Executive Helicopter . . . Maintained in new condition throughout for the exclusive use of a high ranking government official • 250 hours total time • Janitrol heater • floats • skida • skiis • all modifications up • payload for 2 persons and 2:20 hours range • exceptional discount.

TIMMINS AVIATION LIMITED
MONTREAL AIRPORT, CANADA

FOR SALE
HIGH PRESSURE BOILER

30,000 pound steam per hour Combustion Engineering boiler, type VU, two drum, bent tube, 450# steam pressure, 825° FTT, complete with spreader stoker and automatic control.

New 1950—Excellent Condition

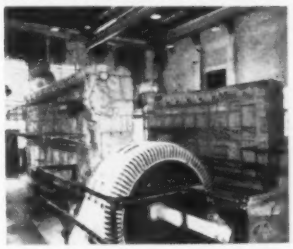
INTERNATIONAL POWER MACHINERY COMPANY
1612 Union Commerce Building
Cleveland 14, Ohio MAin 1-9514

• AVAILABLE FOR IMMEDIATE DELIVERY •

1400 KW FAIRBANKS MORSE—MODEL 33F16—Located Honolulu, T. H.

- New 1948
- Less than 15,000 hours total operation
- Will convert to dual fuel

1000 KW SUPERIOR—MODEL 80SX—Located Tavernier, Fla.



- New 1951
- Less than 15,000 hours operation since rebuild
- Will convert to dual fuel

Units Can Be Seen in Operation in Present Locations

• WRITE FOR DETAILED SPECIFICATIONS •

DIESEL ENGINES — POWER MACHINERY
100 KW to 1500 KW
Diesel Generator Sets • Stationary • Portable • Mobile Motors and Generators

A. G. SCHOONMAKER COMPANY, INC.
MAIN OFFICE: Box 516, Sausalito, Calif. EDgewater 2-1490 BRANCH: 50 Church St., N. Y. 7, N. Y. Digby 9-4350

BENJAMIN F.

SHAW

COMPANY

WAREHOUSE DIVISION

Available for immediate delivery: a wide selection of seamless alloy piping materials to ASTM-Spec. A-335:

99′	3″	Sch	80 — Gr P1
400′	4″	Sch	40 — Gr P1
200′	4″	Sch	80 — Gr P1
25′	6″	Sch	40 — Gr P1
180′	8″	Sch	40 — Gr P1
23′	8″	Sch	30 — Gr P1
422′	3″	Sch	160 — Gr P2
51′	4″	Sch	120 — Gr P2
110′	6″	Sch	40 — Gr P2
67′	8″	Sch	40 — Gr P2
22′	10″	Sch	100 — Gr P2
20′	16″	Sch	100 — Gr P2
68′	2½″	Sch	40 — Gr P5
140′	2½″	Sch	80 — Gr P5
87′	3″	Sch	40 — Gr P5
200′	3″	Sch	80 — Gr P5
200′	4″	Sch	40 — Gr P5
160′	4″	Sch	80 — Gr P5
33′	6″	Sch	40 — Gr P5
25′	6″	Dble Ex Hy	— Gr P5
17′	6″	Sch	160 — Gr P5
110′	8″	Sch	40 — Gr P5
113′	8″	Sch	80 — Gr P5
12′	8″	Sch	160 — Gr P5
187′	10″	Sch	60 — Gr P5
300′	2½″	Sch	80 — Gr P11
550′	3″	Sch	40 — Gr P11
460′	3″	Sch	80 — Gr P11
340′	3″	Sch	160 — Gr P11
85′	4″	Sch	40 — Gr P11
600′	4″	Sch	80 — Gr P11
120′	4″	Sch	160 — Gr P11
47′	4″	Dble Ex Hy	— Gr P11
23′	5″	Sch	160 — Gr P11
70′	6″	Sch	40 — Gr P11
440′	6″	Sch	80 — Gr P11
1800′	6″	Sch	160 — Gr P11
50′	6″	Dble Ex Hy	— Gr P11
300′	8″	Sch	40 — Gr P11
1070′	8″	Sch	80 — Gr P11
1345′	8″	Sch	160 — Gr P11
41′	8″ x 1.264″ Nom. Wall		— Gr P11
25′	8″ x 1.25″ Nom. Wall		— Gr P11
1080′	10″	Sch	60 — Gr P11
1076′	10″	Sch	80 — Gr P11
28′	10″	Sch	120 — Gr P11
43′	10″	Sch	160 — Gr P11
53′	10″ x 1.563″ Nom. Wall		— Gr P11
95′	12″	Sch	80 — Gr P11
95′	12″	Sch	100 — Gr P11
24′	12″	Sch	120 — Gr P11
324′	14″	Sch	80 — Gr P11
22′	14″ x 1-13/16″ Nom. Wall		— Gr P11
170′	16″	Sch	80 — Gr P11
33′	18″	Sch	100 — Gr P11
17′	24″ x ¾″ Nom. Wall		— Gr P11
68′	3″	Sch	160 — Gr P12
20′	5″	Sch	40 — Gr P12
180′	5″	Sch	160 — Gr P12
27′	6″	Sch	80 — Gr P12
31′	8″	Sch	100 — Gr P12
55′	8″	Sch	20 — Gr P12
22′	8″	Sch	40 — Gr P12
54′	10″ x 7/16″ Nom. Wall		— Gr P12
33′	24″	Sch	40 — Gr P12
225′	3″	Sch	80 — Gr P22
780′	4″	Sch	40 — Gr P22
86′	4″	Sch	80 — Gr P22
50′	6″	Sch	80 — Gr P22
46′	6″ x 1.10″ Nom. Wall		— Gr P22
330′	8″	Sch	80 — Gr P22
12′	8″ x 1.212″ Nom. Wall		— Gr P22

All items in stock subject to prior sale. Mill test reports furnished on request. For further information and prices . . . to place your order . . . contact

BENJAMIN F.

SHAW

COMPANY

Warehouse Division

2nd & Lombard Streets • Wilmington, Delaware

Telephone: OLympia 8-7181

Dependable piping fabrication and installation since 1893

POWER PLANT EQUIPMENT FOR SALE

TURBO GENERATORS — CONDENSING

1—G.E. Co., 5,000 KW Curtis steam turbine, condensing 5 stage, form J, 175 lb. steam pressure, connected to: 5,000 KW A.C. generator, type ATB-2-6250M-3600, form HT, 1,569 amps., 2,300 volts, 3 phase, 60 cycle, 3,600 RPM, 80% power factor unit complete with control panels, valves, and steam piping.

1—W.E. & M. Co. 12,500 KVA, steam turbine, condensing, 1,800 RPM, 175 lb. steam pressure, connected to: 12,500 KVA, A.C. Generator, 11,000 volt, 3 phase, 60 cycles, 656 amps., per terminal, 1,800 RPM direct connected to: 100 KW D.C. Generator, 125 volt, 800 amps., 1,800 RPM.

1—W.E. & M. Co. 3,750 KVA, steam turbine, condensing 3,600 RPM 175 lb. steam pressure, connected to. 3,750 KVA A.C. Generator, 2,400 volts, 3 phase, 60 cycle, 904 amps., per terminal, 3,600 RPM, connected to: 25 KW, D.C. Generator, 125 volts, 160 amps., 360 RPM.

BOILERS

5—B.W. Boilers—512 H.P.—180 lb. W.S.P.
3—Edgemoor—500 H.P.—180 lb. W.S.P.
All related equipment—soot blowers, forced draft fans, feed water heaters, water filters, etc.

COMPLETE COAL HANDLING EQUIPMENT

Crushers, pulverizers, tipples, 24″ belt conveyors, hoppers, bucket conveyors, weigh systems—drag line—motors, speed reducer, etc.

TRANSFORMERS

3—W.E.M. Single phase, primary volts 33000/46,200—11,000 volts—4167 KVA.

ELECTRICAL EQUIPMENT

M G Sets—Disconnect switches—Circuit Breakers—Controls, etc.

MISCELLANEOUS

Air Compressors—motors from 1 H.P. to 500. All sizes of pumps—valves—Steel and cast iron pipe to 1″-24″. Steel and wooden tanks. Water screens—water sprays. 15 Ton Northern Bridge crane—26′ 6″ span, etc.

Inspection Invited

Job Site — Hazard, Kentucky

Reply to:

PLATNICK BROTHERS

BLUEFIELD, VIRGINIA

Phone: FAirfax 6-1115

TRANSFORMERS—60 CYCLE

Qu	KVA	Make	Type	Phase	Voltages
2	3000	Moloney	TCR	3	7200/6600-4160/2400
2	750	G.E.	K	1	4800-120/240
1	750	G.E.	KT	3	4150Y-208/416
3	500	West.	SL		4800/2400-240/480
1	300	West.	Power Ctr.	3	2400/4160Y-240/480
1	300	Penna.	(Askarel)	3	12470Y/7200-240
2	250	G.E.	H Pyranol	1	4800/8320Y/120/240
2	250	West.		1	2300/4600-230/460
1	225	Kuhlman	OISC	1	440-100 (Furn.)
3	200	G.E.	H	1	7800-15600-220/440
1	150	Eisler	OA	1	4160-240/480
3	100	G.E.	H		2400/4160-240/480
3	50	G.E.	HS	1	2400/4160/240/120
1	50	Amer.	Abestol	3	4160-120/208Y
5	50	G.E.	HS	1	2400/4160-240/480
4	28	West.	Hypersil	1	2400/4160-120/240
3	15	West.	H Pyranol	1	6900/11950Y-120/240

MOTOR GENERATOR SETS

Qu	KW	Make	Speed	DC	AC
3	60	E.M.	1200	125	220 v. Syn.
1	75	G.E.	1200	125	2300/4160 Syn.
2	100	West.	1200	250	2300/4160Y Syn.
1	175	West.	1200	125	4150 Syn.
1	300	G.E.	1200	250	2300/4160Y S.R.
1	300	G.E.	1200	250	440 Sync.
1	1000	West.	720	600	2300/4160Y

ENGINE GENERATOR SETS

1—Hercules Gas EXE 62.5 KVA Westghe 3/60/480—1200
1—Wisconsin Gas (Air) PE-99 7.5 KVA Master 1 or 3/120—2200 r.p.m. NEW.

SLIP RING MOTORS

Qu	HP	Make	Speed	Type	Volts
2	40	West.	690	CW	220/440
1	60	G.E.	1800	MT	220
1	75	G.E.	600	IM	440
2	100	West.	1800	T.E.F.C. B.B.	220
3	150	Allis-Ch.	1800	AY-RW	2300
1	200	West.	514	CW	440
1	250	West.	600	CW	440
1	350	West.	1800	CW	2300
1	500	G.E.	450	MT	2200
1	500	G.E.	1200	M568Z	2300/4160Y

D.C. MOTORS—230 VOLTS

Qu	HP	Make	Speed	Type
1	75	Cr. Wh.	860	WP 53 H
1	75	Star	1200	SB 60 L B.B.
1	350	G.E.	1200	Pedestal

SQUIRREL CAGE MOTORS, 3 PHASE, 60 CYC.

1—300 HP 1800 RPM G.E. Type K 6336S 4150V
1—275 HP 1180 RPM GE Type KT 559BS 2200V
2—200 HP, 1790 RPM, Gen. Elec. KF, TEFC, 2300V

MOTORS—SYNCHRONOUS—3 phase, 60 cycle

125 HP 600 RPM G.E. Type TS 2200 V.
125 HP 900 RPM G.E. Type TS 4800 V.
150 HP 1800 RPM G.E. Type TS 220 V.
300 HP 720 RPM Elec. Machinery t.e.f.c. 2300 V.
400 HP 450 RPM Westinghouse Type HR 440 V.
1000 HP 360 RPM Westinghouse Ped. Type 2300 V.

"FOR POWER"

J.L. HEMPHILL & CO.

1603 54th STREET, NORTH BERGEN, N. J.

PHONE NEW YORK: LONGACRE 5-3727

PHONE NEW JERSEY: UNION 3-2600

RE-POWER OR NEW POWER

1500 HP Westinghouse unused DC 525V 600 RPM, 40° C.

At Unheard of Value $4,750 ea.

ALBERT HELLER

87 HAMILTON AVE., BROOKLYN 31, N. Y.
ULSTER 5-8643

COMPLETE BOILER INSTALLATION

Excellent Condition

One 190 HP Henry Vogt Water Tube Boiler with combustion, Engineering Underfed Stoker, all complete with motors, blowers, feed units, fans, controls, structural supports, baffles, valves, 48″ by 70′ steel smokestack, etc.

CONDENSATION UNIT

One H520 heavy duty condensation unit.

STEAM HEATING COILS

Sixteen American Blower Corp. #S-2R-18-66F Steam Heating Coils with Aluminum Fins.

For further details and price, write:

OWENSBORO SEWER PIPE CO.
OWENSBORO, KENTUCKY

FOR SALE—2—Elliott Deaerating Feed Tanks for heating & deaerating boiler feed water—rated at 246,500# per hr.—1000 gal. capy—MONEL construction—NEW, at fraction of original price. LEWON BROS. 367 Bayshore Blvd., S.F. 24, Calif. Phone AT 2-2726.

BOILERS

HI-PRESSURE

Complete stock from 10-2,000 h.p.
Nation's largest inventory, New & Used

WABASH POWER EQUIPMENT CO.
9750 Skokie Blvd., Chicago (Skokie) Ill. OR 3-8118

FOR SALE GENERATORS

One 200 K.W. and one 150 K.W., General Electric D.C. generators, 250 volts, 800 and 600 amp. driven by 20″ x 24″ and 18″ x 24″ Chuse steam engines (130 psi steam) complete with controls. Very good condition. May be seen in operation.

MALLINCKRODT CHEMICAL WORKS
3600 N. Second Street St. Louis 7, Mo.

FOR SALE—EXCEPTIONAL BARGAINS

Diesel Generator Units, 200 KW-1500 KW — Turbo Generators, 500 KW-10,000 KW
Motor Generator Sets—Rotary Converters—Synchronous Condensers—
Frequency Changers—Transformers—Pumps, Boilers.

UTILITIES MACHINERY CORPORATION

1965 East Sixth St., Cleveland 14, Ohio • PHONES: CHerry 1-0210 & CH 1-4070

BARGAINS NEW CONDENSER

11000 SQ. FT. UNITS

3 New Worthington Surface Condensers—11000 sq. ft. each—single pass—Monel water boxes—Cupro-Nickel tubes & tube sheets. Tubes ¾ O.D. CAPACITY lbs/hr—70,000; circulating water 14180; circulating water connections 30"; operating weight 86,000 lbs.; overall length approx. 21'; width & height 24". Built for U.S. Navy. Designed for low head room.

8900 SQ. FT. UNITS

1 New unit by C. H. Wheeler. Test pressure: shell 30 lbs; water box 30 lbs.—single pass. Turbine steam exhaust inlet 6' 13¼" x 10' 2". Overall width 12' 2¼"; overall length 14' 10¾"; overall height 5'7". Water inlet 36" x 30" outlet. Monel heads and water boxes; Cupro-Nickel tubes. Built for U.S. Navy of very best materials.

1135 SQ. FT. UNITS

2 New Units by C. H. Wheeler. 2-pass—shell 30 PSI—tubes, chest 30 PSI: DIMENSIONS: 42" diam.—12' long. 24" exhaust steam inlet—water box inlet & outlet 10". 9300 lbs./hr. steam capacity; 1175 GPM circulating water. Complete with twin air ejectors type 4H Wheeler with inner cooler. Built originally for Navy.

580 SQ. FT. UNITS

6 New units—Capacity: 4300 lbs/hr on 28.5 vacuum. 8" water inlet & outlet—18" steam inlet. 2 pass— complete with air ejectors.

3 LIBERTY SHIP TYPE UNITS

2700 Sq. Ft.—2-pass type.

OTHER SIZES IN STOCK FOR IMMEDIATE DELIVERY

NEW CIRCULATING PUMPS

1 only—vertical circulating pump—all-bronze propeller type—geared turbo driven—840 RPM—26500 GPM at 25' head. W.P. turbine, Westinghouse, 575 lbs—0°F superheat. Pump—Warren type 25 VP.

THE BOSTON METALS CO.
313 E. BALTIMORE STREET
BALTIMORE 2, MD. ELgin 5-5050

POWER EQUIPMENT

300 KW G.E. Non-C. Turbo. Generator 3/60/480 V 150# 5-10#-BP. 3600 RPM

45000# Combustion Engineering BOILER 450# 750° TT oil fired

500 KVA 3 ph 60 cy 4150 V G.E. FEEDER VOLTAGE REGULATOR step type MLT-32—New

BREW, WOLTMAN & CO., INC.
50 Church St., New York 7, N. Y.

1902 COMPRESSORS 1958
WORLD'S BEST REBUILTS

100 CFM	125 psi	6x7 Ing.
138 CFM	100 psi	7x7 Ing. ES-1
191 CFM	350 psi	9-4x9 Ing. FS-2
238 CFM	100 psi	9x9 Eng. ES
268 CFM	500 psi	10-4¼x10 Ing. or Worth.
465 CFM	100 psi	12x11 Ing.
496 CFM	Vacuum	14x7 Chicago TVB
502 CFM	125 psi	12x13 Worth. HB.
585 CFM	100 psi	15-9¼x12 Ing. XRE 3-60-4160
590 CFM	100 psi	13½-8x8 Penn DE2 3-60-220
628 CFM	100 psi	14x13 Worth HB
676 CFM	100 psi	15-9¼x12 Ing. XRB—Worth.
870 CFM	125 psi	17-10½x12 Ing. XRE 3-60-220
1007 CFM	100 psi	19-11x12 Chic. OCB
1008 CFM	125 psi	16/10½x8½ Worth YC-2
3864 CFM	125 psi	33-20½x24 IR-PRE. 700 H.P. 3-60-2300—see running

PORTABLES—55-60 CFM Rotary or Reciprocating

AMERICAN AIR COMPRESSOR CORP.
Dell Ave. & 47th St. North Bergen, N. J.
UNion 5-4848

CHECK WITH WAGNER FIRST!

Thousands of new and "Certified Rebuilt" Motors & Generators in stock—up to 1000 H.P. OUR 52nd YEAR

A. C. MOTORS—60 CYCLE

HP	Mfr.	Type	Volts	Speed
800	Whse. (2)	Sq. Cage	2300	1800
700	Whse.	Slipring	2300/4000	1200
600	Elliott (2)	Sq. Cage	2300	900
500	Whse.	Slipring	2300	514
500	Whse.	Slipring	2200	450
400	Whse. (2)	Synch.	2200	1800
400	Whse.	Sq. Cage	2200	514
400	Marathon (2)	Sq. Cage	2200	3600
400	Whse.	Sq. Cage	2300	900
400	G.E. (2)	Slipring	440	900
400	G.E.	Slipring	2300	514
350	G.E.	Sq. Cage	2200	1800
350	G.E.	Slipring	440	1200
350	Allis Ch.	Slipring	2200/4000	600
300	El. Mach. (2)	Synch.	2200/440	720
300	G.E.	Slipring	2200/440	600
300	G.E. (2)	Synch.	2200/440	360
300	Whse.	Synch.	440	1200
250	G.E.	Sq. Cage	2200/440	1200
250	Gen. Elec.	Sq. Cage	440	3600
250	G.E.	Slipring	220/440	720
250	G.E.	Sq. Cage	2200	1800
225	G.E.	Synch.	220/440	900
200	L.A. TEFC	Sq. Cage	440	1200
200	G.E.	Slipring	2200	900
200	Reliance b.b.	Sq. Cage	220/440	1800
200	Allis Ch.	Slipring	440	450
200	Allis Ch.	Slipring	2200/440	720
200	Whse.	Sq. Cage	2200/440	900
175	G.E. (2)	Synch.	220/440	720
150	Rel. TEFC	Sq. Cage	220/440	900
150	G.E. (4)	Slipring	2200/440	600
150	Cr. Wheeler	Sq. Cage	220/440	450
150	G.E. (2)	Sq. Cage	2200/440	1800
150	Whse.	Slipring	220/440	1200
125	G.E. TEFC	Sq. Cage	2200	3600
125	Ideal	Slipring	4000/2200	600
125	Al. Ch. TEFC	Sq. Cage	220/440	600
100	Whse. TEFC	Sq. Cage	220/440	900
100	Smith b.b. (4)	Sq. Cage	220/440	1800

D. C. GENERATORS

KW	Mfr.	Type	Volts	Speed
200	Gen. Elec.	RC	250	1450
150	Whse.	SK-184	250	1150
150	Cr. Wh.	CCD	250	650
125	Gen. Elec.	CD	250	1150
100	Allis Ch.	E	125	1200
100	Reliance	651-T	600	1200
75	Gen. Elec.	CD-123	125/250	1200
60	Allis Ch. (3)	E-146	250	1500
60	Ideal	D	125	1150
25	Whse.	SK-103	250	1750

D. C. MOTORS

HP	Mfr.	Type	Volts	Speed
250	Cr. Wh.	101-H	230	1150
200	G.E. (2)	RC-38	230	1150
170	Cr. Wh.	151-H	230	900
150	Whse.	SK-184	230	850
150	Whse.	SK-210	230	325/1000
150	G.E.	CD-173	230	575/1150
100	Reliance	651-T	550	1000/1600
100	Elliott b.b. T.E.	JH-FE	230	1150
75	Whse. (4)	SK-163	230	500/1500
60	G.E. TEFC b.b.	CD-135	230	1150
50	Century	DN-514	230	1150/1750
50	Gen. Elec.	CD-95	230	1800
50	G.E.	CD-125	230	400/1200
50	G.E.	RF-16	230	250/1000
40	G.E. (2)	CD-93	230	1750
25	Whse. (2)	SK-153	230	300/1200

MOTOR-GENERATOR SETS

KW	Mfr.	Input V	Output V
600	Allis Ch.	440 AC	250 DC
200	Gen. Elec.*	220/440 AC	125 DC
200	G.E.	2200/440 AC	600 DC
175	Gen. Elec.	220/440 AC	250 DC
125	Gen. Elec.*	2300/4000 AC	250 DC
75	Star b.b.	220/440 AC	250 DC
75	G.E.	220/440 AC	125 DC
60	Allis Ch.	220/440 AC	250 DC
50	Cr. Wh. b.b. (2)	220/440 AC	250 DC

Arthur Wagner Co. Certified
MO nroe 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

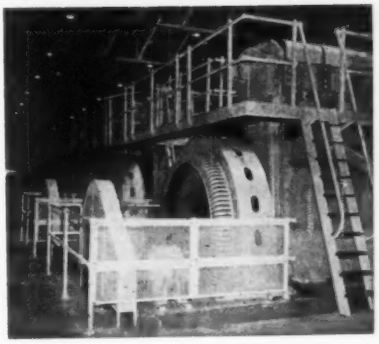
FOR SALE

1 — 600 H.P. B & W horizontal water tube BOILER, 200 psi, ASME, 2 drum, oil fired. Completely instrumented.

2 — 200 K.W. and 1 — 240 K.W. Fairbanks Morse DIESEL ENGINE GENERATOR SETS, 240 volt, 247 RPM.

1 — 200 K.W. Worthington DIESEL ENGINE GENERATOR SET, 240 volt, 400 RPM. Available for immediate delivery

CAMDEN FORGE COMPANY
Box 269 Hoboken, N. J.
NY Telephone BArclay 7-0600



13,750 KVA POWER PLANT. STILL INSTALLED. Will be sold as complete unit or piece by piece. Consists of (11) 1250 KVA Rathbun-Jones Natural Gas Generator Sets. **ENGINES**—1430 HP, 8 Cylinder, 4 Cycle, 300 RPM, direct connected to **GENERATORS**—1250 KVA, .8 PF, 3/60/2400-4160. Complete with Switchgear. Can be seen in operation on foundations. **PRINTS** and Photos available. Write **HEAT & POWER CO., INC., POWER EQUIPMENT DIVISION,** 60 E. 42nd St., New York 17, N. Y.

BOILERS, PACKAGE TYPE

B&W. 1000 HP. designed for max. 400 lb. steam pressure. Oil fired.

2 Edgemoor, 1300 HP., designed for max. 400 lb. steam pressure.

BONDED EQUIPMENT CO.
24155 Schoenherr, Warren, Mich.
PRescott 8-6640

SAVE 50% or more . . . On Transformers & Regulators!

NEW and USED surplus transformers and regulators available at considerable savings. 25 KVA to 10,000 KVA. Write for prices, giving specifications.

INDUSTRIAL ELECTRIC CO.
Box 661 Moultrie, Ga.

FOR SALE—MODERN NON-CONDENSING TURBINE GENERATOR UNIT

750 KW, 80%, PF, 3/60/2400 volt Elliott 250 PSIG, 600°FTT, 50# gauge back, suitable for 400 PSIG.

EUCLID ENGINEERING CORPORATION
609 National City East Sixth Building
Cleveland 14, Ohio

Advertisers' Index

A

Aerotec Corp. ... 145
Air Preheater Corp. ... 159
Alco Products, Inc. ... 191
Allen-Sherman-Hoff Co. ... *
Allgemeine Elektricitats-Gesellschaft ... Second Cover
Allis-Chalmers Mfg. Co. ... 63, 194-195
Allpax Company, Inc. ... *
Aluminum Company of America ... 112
American Blower Div. ... 220
American Engineering Co. ... 225
American Gilsonite Co. ... *
American Pulverizer Co. ... 164
American Water Softener Co., Inc. ... 210
Ames Iron Works, Inc. ... 169
Anchor Packing Co. ... 165
Armstrong Machine Works ... 137
Atomics International, Div. of North American Aviation, Inc. ... *

B

Babbitt Steam Specialty Co. ... 210
Babcock & Wilcox Co. ... 6-7
Badger Mfg. Co. ... *
Bailey Meter Company ... 12-13
Baldwin-Hill Co. ... *
Baltimore & Ohio Railroad ... *
Barber-Colman Co. ... *
Bell & Gossett Co. ... 143
Belmont Packing & Rubber Co. ... *
Betz Laboratories, Inc. ... 179
Biddle Co., James G. ... 200
Bituminous Coal Institute ... 40-41
Black, Sivalls & Bryson, Inc. ... *
Blaw-Knox Co., Equipment Div. ... 60
Boiler Tube Co. of America ... *
Bridgeport Brass Co. ... *
Bros Incorporated Power Div. ... 50-51
Brown Boveri Corp. ... 223
Buell Engineering Co. ... 208
Buffalo Forge Co. ... 22-23
Buffalo Pumps, Inc. ... 175
Bussmann Mfg. Co. ... 74-75
Byron Jackson Pumps, Inc. ... *

C

Calgon Company ... *
Carpenter Steel Co., Alloy Tube Div. ... *
Catawissa Valve & Fittings Co. ... *
Celanese Corp. of America Chemical Div. ... *
Chapman Valve Mfg. Co. ... 52-53
Chase Brass & Copper Co. ... *
Chesterton Co., A. W. ... *
Chicago Blower Co. ... *
Chicago Pneumatic Tool Co. ... 16-17
Clarage Fan Co. ... 201
Cleaver-Brooks Co., Boiler Div. ... 192
Cochrane Corporation ... 61
Combustion Engineering, Inc. ... 20-21
Condenser Service & Engrg. Co. ... 212
Conoflow Corp. ... *
Cooper-Bessemer Corp. ... *
Copes-Vulcan Div., Blaw-Knox Company ... 14-15
Coppus Engineering Corp. ... 64
Crane Company ... 4, 149
Crane Packing Company ... *
Crawford Fitting Co. ... *
Cyclotherm Div., National-U. S. Radiator Corp. ... 32

D

Deady Chemical Co. ... *
Dearborn Chemical Co. ... *
DeLaval Separator Co. ... *
DeLaval Steam Turbine Co. ... 2, 170, 171
Detroit Controls Div. of Amer. Standard ... 198
Detroit Stoker Co. ... 213
Diamond Power Specialty Corp. ... 8-9, 153, 168
Dodge Mfg. Corp. ... *
Dow Chemical Co. ... 48
Dow Corning Corp. ... *
Dravo Corporation ... 70

E

Eagle Picher Company ... *
Edward Valves, Inc. ... 42-43
Electric Machinery Mfg. Co. ... 216
Elgin Softener Corp. ... *
Elliott Company ... 10-11, 172
Elliott Company—Roto Plant ... 178
Engineer Company ... *
Erico Products, Inc. ... 174
Erie City Iron Works ... *

F

Fairbanks Company ... *
Fibreboard Paper Products Corp., Pabco Ind. Insulations Div. ... *
Fisher Governor Co. ... 30-31
Flexitallic Gasket Co. ... 69
Fly Ash Arrestor Corp ... *
Foster Co., Benjamin ... *
Foster Wheeler Corp. ... 49, 141
Foxboro Company ... *
Frick Company ... 202
Fuller Company ... *

G

Garlock Packing Company ... *
Gates Rubber Co. ... 196
General Controls ... 193
General Electric Co. Apparatus Dept. ... *
Goulds Pumps, Inc. ... 66
Grinnell Company ... 68
Griscom-Russell Co. ... *

H

Hagan Chemicals & Controls, Inc. ... *
Hall Laboratories ... 72
Harbison-Walker Refractories Co. ... *
Hartman-Walsh ... 228
Hays Corporation ... *
Heyl & Patterson, Inc. ... 62
Hoffman Specialty Mfg. Corp. ... *

I

I-T-E Circuit Breaker Co. R & IE Equipment Div. ... 226
I-T-E Circuit Breaker Co. Switchgear Div. ... *
Illinois Water Treatment Co. ... *
Industrial Instruments, Inc. ... *
Infilco Inc. ... 203
Ingersoll-Rand Co. ... 26-27
International Nickel Co., Inc. ... 65
Iron Fireman Mfg. Co. ... *

J

Jeffrey Mfg. Co. ... 207
Jenkins Bros. ... 139
Jerguson Gage & Valve Co. ... 167
Johns-Manville ... 28-29, 158
Johnson Service Co. ... 185
Jones & Laughlin Steel Corp. ... *

K

Keasbey & Mattison Co. ... 224
Keeler Co., E. ... 147
Kennedy-Van Saun Mfg. & Engrg. Corp. ... 199
Kewanee Boiler Div. ... *
Kieley & Mueller, Inc. ... 58
Kirk & Blum Mfg. Co. ... *
Klipfel Valves, Inc. ... *
Koppers Co., Inc. Aeromaster Fan Dept. ... *
Koppers Co., Inc. Coupling Dept. ... *
Koppers Co., Inc. Wood Preserving Div. ... *

L

Laclede Stoker Co. ... 180
Leeds & Northrup Company ... *
Leslie Company ... *
Limitorque Corp. ... 219
Link-Belt Company ... 1
Lockett & Company, Ltd., A. M. ... *
Lonergan Co., J. E. ... *
Lukens Steel Co. ... 205
Lunkenheimer Company ... *

This index is a service to readers. Every effort is made to maintain its accuracy, but POWER cannot assume responsibility for errors or omissions. When a star appears after the name, the advertisement does not appear in this issue but appeared in an issue within the previous three months.

M

Magnaflux Corp. *
Manning, Maxwell & Moore, Inc. 209
Marley Company *
Marsh Instrument Co. 211
Mason-Neilan Div. of Worthington Corp. *
McDonnell & Miller, Inc. 71
McNally Pittsburg Mfg. Corp. 190
Mesta Machine Co. *
Midwest Piping Co., Inc. 181
Minneapolis-Honeywell 215
Murray Iron Works Co. 189
Murray Mfg. Co., D. J. *

N

National Airoil Burner Co., Inc. 204
National Aluminate Corp. *
National Tube Div. *
National Valve & Mfg. Co. *
Niagara Blower Co. *
Nicholson & Co., W. H. Third Cover
Nordberg Mfg. Co. 39
Normandy Electric Wire Corp. *

O

Ohio Brass Company *
Ohio Injector Company *
Orr & Sembower, Inc. 154-155

P

Panalarm Div. of Panellit, Inc. *
Patterson-Kelley Co. 59
Peabody Engineering Corp. *
Peerless Pump Div., Food Machy. & Chemical Corp. *
Pennsylvania Flexible Metallic Tubing Co. *
Permutit Company 221
Phelps Dodge Copper Products Corp. *
Philadelphia Gear Corp. 219
Phoenix Mfg. Co., Flange & Forging Div. *
Pioneer Service & Engrg. Co. *
Pipe Fabrication Institute *
Pittsburgh Piping & Equipment Co. 76
Porter Co., Inc., H. K. Forge & Fittings Div. *
Powell Co., Wm. 160
Powers Regulator Co. *
Pratt Company, Henry *
Preferred Utilities Mfg. Co. *
Pritchard & Co., J. F. *

R

R-P & C Valve Div., Amer. Chain & Cable Co., Inc. *
Raybestos-Manhattan, Inc. Manhattan Rubber Div. *
Raybestos-Manhattan, Inc. Packing Div. *
Reliance Gauge Column Co. 176
Republic Flow Meters Co. 46-47
Republic Steel Corp., Steel & Tubes Div. 24-25
Research-Cottrell, Inc. *
Ric-Wil Incorporated 217
Ridge Tool Company 67
Riley Stoker Corporation 110-111
Rohm & Haas Co. 54
Ross Heat Exchanger Div. *

S

Sarco Company *
Schaub Engrg. Co., Fred H. 182
Scovill Mfg. Co. *
Sinclair Refining Co. *
Smith Company, S. Morgan 222
Smith Corporation, A. O. *
Southwestern Engineering Co. 218
Spence Engineering Co. *
Standard Oil Co. of Indiana 173
Stickle Steam Specialties Co. *
Stock Equipment Co. *
Strong, Carlisle & Hammond *
Superior Combustion Industries, Inc. 163

T

Taylor Forge & Pipe Works 33-34-35-36-37-38
Terry Steam Turbine Co. 197
Texas Company *
Todd Shipyards Corp., Products Div. *
Tube-Turns, Inc. 183-184

U

Union Asbestos & Rubber Co. *
Union Iron Works *
United States Gauge 188
United States Steel Corp. 57
Universal Atlas Cement Co. *

V

Vapor Heating Co. 214
Viking Pump Co. *
Vogt Machine Company, Henry 177

W

Wallace & Tiernan Inc. 206
Walworth Company 187
Warren Pumps, Inc. 186
Western Chemical Co. *
Western Precipitation Corp. *
Westinghouse Electric Corp. 44-45
Westinghouse Electric Corp. Sturtevant Div. 166, 167
Wheeler Mfg. Co., C. H. *
Where To Buy 229
Wickes Boiler Co. *
Wolverine Tube Div. of Calumet & Hecla, Inc. *
Worthington Corp. 55-56, Back Cover

Y

Yarnall-Waring Company 18-19, 131, 171
York-Shipley, Inc., Industrial Div. 227
Yuba Heat Transfer Div. *

Z

Zallea Brothers 240
Ziegler Co., G. S. *

Professional Services **229**

CLASSIFIED ADVERTISING

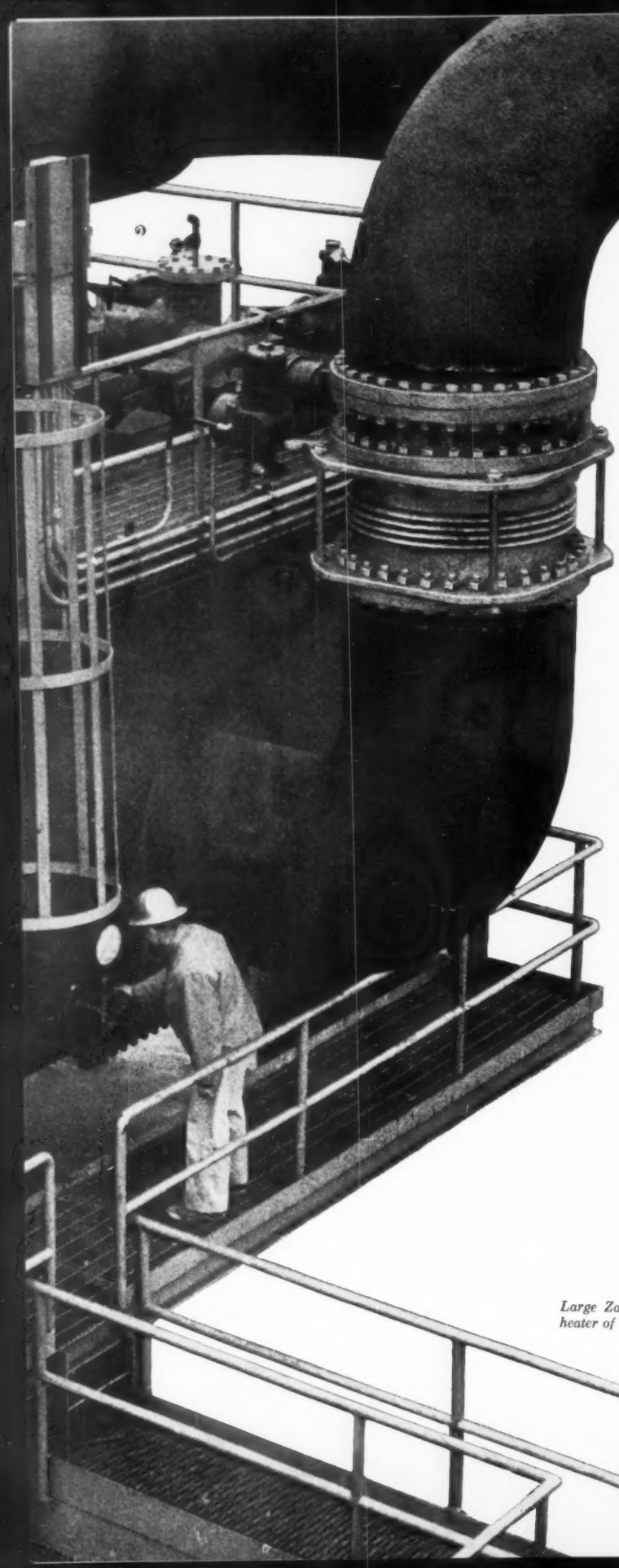
F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES 230

EQUIPMENT
(Used or Surplus New)
For Sale 230-237

ADVERTISERS INDEX

Ajax Electric Motor Corporation 230
Allied Electric & Machinery Co. 234
American Air Compressor Corp. 237
Belyea 232-233
Benson-Wilimzig Inc. 234
Bonded Equipment Company 237
Boston Metals Co., The 231-233-237
Bovay, Jr., H. E. 231
Brew-Woltman 237
Chicago Electric Co. 230
DeRose, G. M. 233
Euclid Engineering Corp. 237
Forge Co., Camden 237
Foster Co., L. B. 234
Grosser Co., Albert 234
Hall & Co., Stephen 232
Heat & Power Co., Inc. 230-231-233-237
Heller, Albert 236
Hemphill & Co., J. L. 236
Hughes Co., Arnold 230
Industrial Electric Co. 237
International Power Machinery Co. 231-235
Lewon Brothers 236
Machinery Co., H & P 233
Mallinckrodt Chemical Works 236
Oberman, Paul 231
Owensboro Sewer Pipe Co., The 236
Pelnik-Loconti Industrial Supply Co. 232
Perry Equipment Corp. 233
Platnick Brothers 236
Power Equipment Company 234
Schoonmaker Co., A. G. 232-235
Shaw, Benjamin T. 236
Timmins Aviation Ltd. 235
Utilities Machinery Corp. 235-236
Wabash Power Equipment Co. 236
Wagner Co., Arthur 237
Weaver, Inc., Charles 231
Whisler Equipment Company 233



Get positive piping protection with

ZALLEA NON-EQUALIZING EXPANSION JOINTS . . .

Zallea Non-Equalizing Corrugated Expansion Joints offer a degree of protection that can't be equalled for absorbing movement of piping due to temperature changes. They protect interconnected equipment by absorbing movements in otherwise rigid piping systems. They are used in low pressure and vacuum lines . . . between stills, tanks, columns, condensers, pumps and similar equipment.

Standard Sizes: 3″ to 72″ dia.; Special sizes to 50 ft. dia. Pressures: Vacuum to 50 psig. Temperatures: to 1600°F.

Special Applications. With the addition of proper components, Zallea Non-Equalizing Expansion Joints can be used as:

Universal Expansion Joints to absorb movement in any direction . . . axially, laterally, angularly, or any combination of these.

Pressure Balanced Expansion Joints to absorb axial movement outside the unit and still carry pressure thrust.

Hinged and Gimbal Expansion Joints for piping systems that cannot be anchored in the conventional manner.

Get the complete story of Zallea Expansion Joints in our new 72-page manual. They are available for any pressure condition to 3600 psig. Write, on your company letterhead, for your copy of Catalog 56.

Zallea
expansion joints

Zallea Brothers • Wilmington 99, Delaware

World's largest manufacturers of expansion joints

Large Zallea Non-Equalizing Expansion Joint installed on deaerating heater of Ford Motor Company's River Rouge plant.

ACTUAL SIZE

GET THE MOST FOR YOUR

BTU DOLLAR

...with Nicholson steam traps

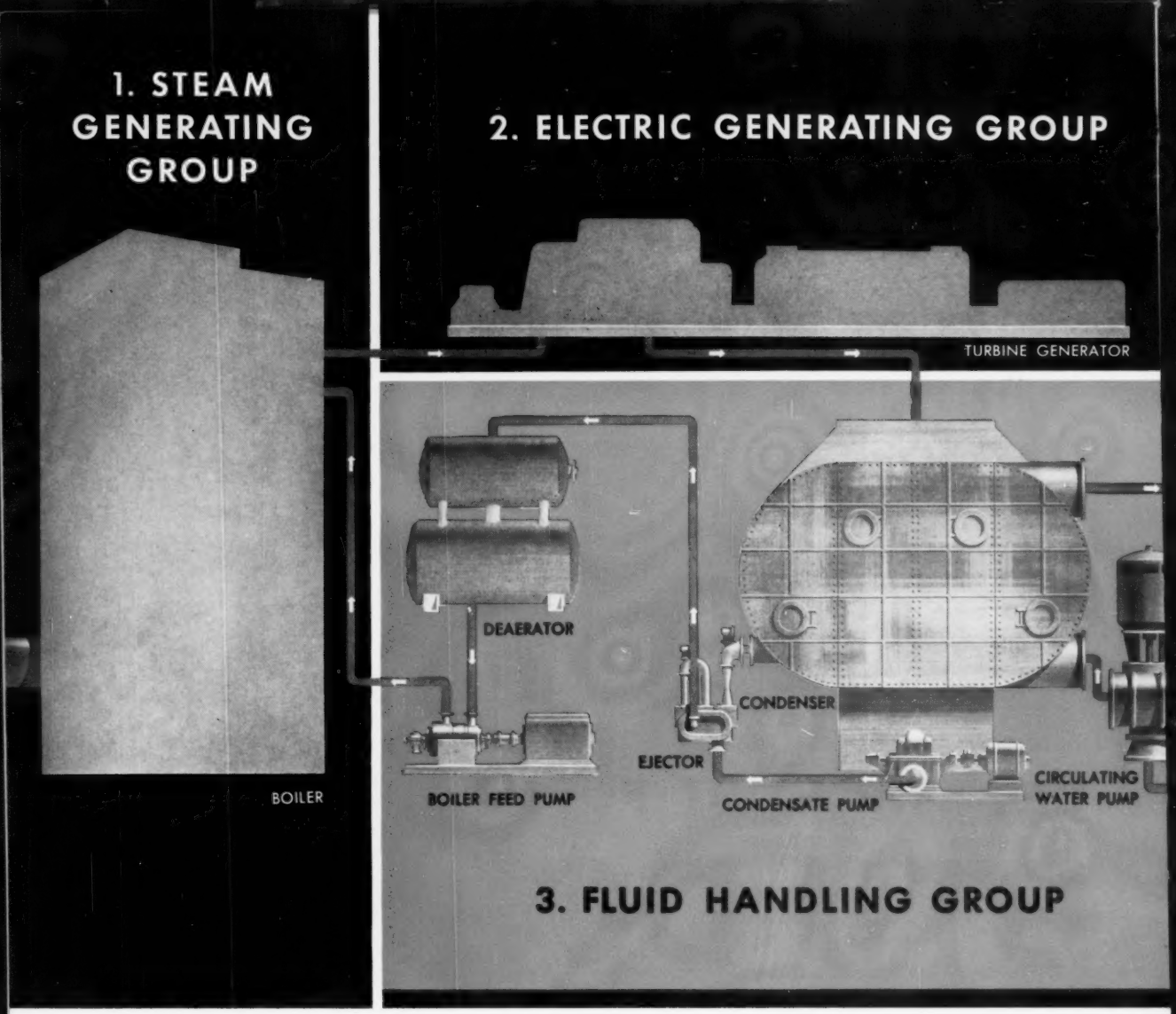
You get top operating temperature per dollar of fuel consumption . . . when you use the Nicholson steam trap. This trap purges all air and non-condensibles from pipes and equipment *continuously* . . . not just at warm-up time. Your boiler doesn't have to operate at top capacity —all the time—to obtain top steam temperature where and when you need it.

Make full use of your BTU dollar, with Nicholson traps. They have only one moving part . . . a valve that operates on just a few degrees of temperature differential.

In your steam generation, and in your steam utilization . . . Nicholson traps will save you money. You can try one . . . without obligation! W. H. Nicholson and Company, 12 Oregon St., Wilkes-Barre, Pa. Sales and Engineering Offices in 98 principal cities.

NICHOLSON

of Wilkes-Barre



LOOK AT ALL THREE FOR POWER

Power plant reliability often depends on the effect of one component of the *Fluid Handling Group* on another. As the manufacturer of all major components of this group, Worthington has a reservoir of experience and knowledge that can benefit you. This "system-wise experience" with modern complex plant equipment can help solve your fluid handling problems. To put "system-wise experience" to work get in touch with your nearest district office. Worthington Corporation, Harrison, New Jersey.

45-3

WORTHINGTON